# PERFORMANCE OF LATEX MODIFIED AND LOW SLUMP CONCRETE OVERLAYS ON BRIDGE DECKS

Addendum Report to MCHRP 83-1

Survey Results of Structures After
9 to 13 years of Service

*(Initial Study 1982-1983; Follow Up Study 1989-1990)*

**Research Investigation 84-2**

*Prepared By*

MISSOURI HIGHWAY AND TRANSPORTATION DEPARTMENT

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## ABSTRACT

The department became concerned when reports from the field cited moderate to severe surface cracking and debonding was occurring on several older rehabilitated and on some of the new two course layered construction overlaid decks. Cores showed cracks extended through the overlay in the majority of cases and in some instances penetrated into the base concrete. To learn the extent of these specific problems, a field investigation of all constructed layered decks was undertaken during the fall of 1982 and concluded in the spring of 1983. Tested were 60 low slump concrete, 7 latex mortar, and 24 latex concrete overlays which had been constructed from 1976 to 1983.

In 1989-1990, a follow up field investigation was conducted using all the bridge decks in the original investigation.

The field investigation included observations of the extent and type of surface cracking, area of debonding and/or delaminating, and area of surface patching. On a limited number of selected bridge structures, voltage potential measurements, chloride ion content, and extent of crack penetration were also included.

The low slump concrete showed considerably more cracking than it had in the original survey as the decks are now 6 to 8 years older. The data did, however, show the same deviation above and below the overall weighted average

cracks per thousand foot as in the original survey. Also, two of the low slump concrete bridges that prompted the original study actually showed less cracks per thousand feet in 1989 than when tested in 1983. This may be because surface cracking seen in the 1983 survey has now worn off because of traffic. The latex concrete and latex mortar overlays showed a moderate increase in surface cracking

In 1983, when the first survey was reported, a total of 91 bridges had received some type of concrete overlay statewide. To date, on the state highway system, there are a total of 556 bridge decks with concrete overlays in Missouri.

It was stated in the original survey report that, "Continued use of latex modified and low slump concrete overlays appear warranted. The least amount of surface cracking was found on decks with minimum overlay thickness of 1 3/4 inches of latex and 2 1/4 inches of low slump concrete." This statement was verified by the follow up survey of 1989-1990.

## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

## LIST OF ABBREVIATIONS

| | |
|---|---|
| ADT | Average Daily Traffic |
| BB-G | Box Beam or Girder |
| Class B-1<br>B-2<br>X | Type of Masonry Concrete Mixes |
| GIRD | Girder |
| LC | Latex Concrete |
| LM | Latex Mortar |
| LSC | Low Slump Concrete |
| OR | Outer Road |
| PYTR | Pony Truss |
| R | Rehabilitated Bridge Deck |
| STRG | Stringer/Multi-Beam or Girder |
| T-BM | Tee Beam |
| THTR | Thru Truss |

# INTRODUCTION

Missouri's geographical location with regard to the freezing index parameter, expressed in degree-days below 32°F, ranges from less than 100 in the southeast (Bootheel) part of the state to an excess of 600 in the northwest part of the state. The use of deicing salts in conjunction with abrasive materials varies widely throughout the state. Since 1970, certain measures have been taken to provide protection for the reinforcing steel in concrete bridge decks against the corrosive affects of deicing salts. Measures utilized include (a) membrane systems, (b) cathodic protection, (c) epoxy coating the reinforcing steel, (d) increasing depth of cover over the top steel, (e) improved mix designs to reduce permeability of concrete, and (f) concrete overlays.

The primary design feature of any concrete overlay, regardless of type, is as a protective barrier system against migration of chlorides to the level of the top reinforcing steel. To provide this protection, the concrete mix designs attempted to achieve a denser concrete surface to abate intrusion of chloride ions. In 1983, when the first survey was reported, a total of 91 bridges including rehabilitated older decks (designated by an "R" following the individual bridge number) and decks of new two course layered construction had received some type of concrete overlay statewide. All of these decks were included in the 1982-1983 report except one for safety reasons. To date, on

the state highway system, there are a total of 556 bridge decks with concrete overlays in Missouri. A list of these bridges is shown in Appendix IV.

When an overlay becomes flawed through either cracking and/or debonding, the system, as such, has lost some measure of its protective capacity. The department became concerned when reports from the field cited moderate to severe surface cracking and debonding was occurring on several older rehabilitated and on some of the new two course layered construction overlaid decks. Cores showed cracks extended through the overlay in the majority of cases and in some instances penetrated into the base concrete. To learn the extent of these specific problems, a field investigation of all constructed layered decks was undertaken during the fall of 1982 and concluded in the spring of 1983.

The original research study covered surveys of all 91 overlaid bridges which were in existence at that time. Some 104 driving (outermost thru) lanes, resulting from many of the bridges being twin structures, were surveyed and categorized by type and design thickness as follows:
(a) 30 latex concrete (LC) ranging from one to two and one quarter inches with the majority one and one half inches, (b) 9 latex mortar (LM) one inch, and (c) 65 low slump concrete (LSC) ranging from one and three quarters to two and one quarter inches with the majority two inches.

The 1989-1990 follow up study covered 90 bridges and 102 driving lanes as follows: (a) 27 latex concrete (LC), (b) 9 latex mortar (LM), and (c) 66 low slump concrete (LSC).

One bridge, L-887R, consisting of twin structures in the EB and WB lanes was not resurveyed, it was redecked with cathodic protection in 1985. Bridge A-3810 OR, outer road, was reported as two bridges, A-3810 OR EB and A-3810 OR WB with no tests done on A-3810 OR WB in the original study. This is in fact a single bridge with two way traffic on it and the EB lane was tested both in the original and the 1989-1990 survey.

Bridge A-3664 EB was listed in Table 10, Item V, of the original study but was still under construction and was not tested. The bridge was accepted in November 1983 and there was some concern about the amount of surface cracking which had been reported, therefore, it was included in the 1989-1990 survey.

## CONCLUSIONS

The following conclusions are based on a 1982-1983 survey of portions of concrete overlaid decks on 91 bridges. The data is updated from the 1989-1990 survey of 90 of the originally surveyed bridges. By convention, the 1982-1983 data appears first or is referred to simply as 1983 data. The 1989-1990 data always follows and is referred to as 1990 data. These overlays, most of which were less than five years old in the 1982-1983 study, were placed on decks of new layered construction and on older rehabilitated decks.

1. Both the extent and severity of surface cracking and debonding and/or delamination of overlays was not found to be a universal problem in the 1982-1983 study. This statement still holds true after the 1989-1990 survey. Most of these overlays are now at least ten years old.
2. Surface cracking was not observed on 78% of the deck areas surveyed in 1983, 48% in 1990.
3. The 2 1/4 inch thick low slump concrete had significantly less cracking than either the 1 3/4 or 2 inch thick low slump concrete in the 1982-1983 survey. This is still true in the 1989-1990 survey. The mean "cracks per thousand square feet" for 2 1/4" low slump concrete, (designated as LSC) was 47.3 linear feet in 1983, 163.1 in 1990, compared to the mean value for 1 3/4" LSC of 57.0,

306.9 in 1990, 2" LSC of 398.0 linear feet, 392.6 in 1990.

4. Debonding and/or delamination was noted on 0.57 percent of the deck areas surveyed in 1983, 1.00% in 1990, representing 2174 of a total area surveyed of 381,336 square feet in 1983, 3652 of a total of 365,885 square feet in 1990.

5. Surface patching was noted on 0.12 percent of the deck areas surveyed representing 458 square feet in 1983. It was 0.22 percent or 825.1 square feet in 1990.

6. Voltage potential readings obtained on 20 deck driving lanes indicated 90.7 percent were in the passive areas of less than -0.20 volts in 1983, on 21 decks, 70.1% were passive in 1990. Some 8.7 percent were in the questionable active or passive range of -0.21 to -0.35 volts, 23.4 percent in 1991. Some 0.6 percent were in the active range of greater than -0.35 volts in 1983, 6.5 percent in 1990.

7. Some 8 of 17 decks tested had two or more pounds of chloride per cubic yard of concrete near the surface of the concrete overlay in 1983 compared to 23 of 31 in 1990. Generally, the concrete overlays are protecting against the migration of chloride ions into the base deck concrete, however, are showing increasing amounts of chlorides within the overlay itself. The overlay

with the highest accumulation of chloride was in the 1" latex mortar overlays, with 4.3 to 7.4 pounds per cubic yard in 1983, 7.8 to 12.9 pounds per cubic yard in 1990. These overlays have protected the original decks as designed, however, because chloride contents of the original concrete deck remained very low in 1990, 0.0 to 2.0 lbs./cy at the 1 1/4" to 1 3/4" horizon and to 0.0 to 0.8 lbs./cy at the 2 3/4" to 3 1/4" horizon. These overlays have been in place for 12 years.

8. Random cores drilled over surface cracks for the 1982-1983 survey indicated cracks extended into the base concrete on 50.0 percent of the 1" thick latex mortar, 29.6 percent of the 2"-2 1/4" low slump, and 14.3 percent of the 1 1/2" thick latex concrete overlay cores on the 15 deck driving lanes surveyed. In the 1989-1990 survey, only one core had a crack extending into the base concrete and this was on the 1" latex mortar. It appears there is more correlation with overlay thickness than type on depth of crack penetration, however, a very large number of cores would need to be taken to verify this. This amount of extra coring doesn't appear to be worthwhile.

9. The depth of crack penetration was found to be independent regardless of the width of the surface crack.

# IMPLEMENTATION

Based on the data resulting from the 1982-1983 study, it was stated the continued use of both latex modified concrete and low slump concrete was warranted. However, the minimum thickness of latex modified concrete was specified to be 1 3/4 inches and low slump concrete to be 2 1/4 inches.

Based on the data resulting from the 1989-1990 study to determine if environmental factors would increase the amount of cracking and debonding and/or delamination of the concrete overlays, it is believed the use of latex modified and low slump concrete overlays is warranted.

On nine deck driving lanes in the 1989-1990 survey, the amount of surface cracking actually went down. This may be because surface cracking seen in the 1983 survey has now worn off because of traffic. This would imply that many of these are surface or plastic shrinkage cracks caused by thermal gradient stresses during curing of the concrete overlay. Some correlation was shown between reduced cracking and thicker overlays and as stated above minimum thicknesses were implemented in 1983. Therefore, it is believed more care should be taken during the curing process. A special curing specification in concrete overlay projects such as ACI 308, Standard Practice for Curing Concrete, using evaporation rate guidelines should be adopted.

## DISCUSSION

This study consists of a state-wide survey of 90 bridge decks utilizing latex modified mortar or concrete and low slump concrete overlays. These overlays were placed on both decks of new two course layered construction as well as on older rehabilitated decks which are designated by an "R" following the individual bridge number. The objective of the study was to determine if some deck concrete overlays exhibiting moderate to severe surface cracking and debonding and/or delaminations were isolated conditions or existed statewide. This cracking consisted primarily of random and transverse cracking with less amounts of longitudinal cracking. As reported, this moderate to severe cracking was primarily occurring on four decks in the Kansas City area. All four of the decks were rehabilitated older decks patched and scarified prior to overlay placement. Considerable cracking was also observed on a new river bridge in the St. Charles area having a two inch low slump concrete overlay.

Excessive debonding was noted on one new constructed bridge with a two inch thick low slump concrete in the Jefferson City area. The deck on this bridge, A-3521, was not scarified before the overlay was placed. The overlay was removed by contract let in May 1984, the deck scarified and a new 2 1/4" low slump concrete overlay placed. It is reported on the 1989-1990 survey as Bridge A-3521R.

The field investigation was generally restricted to the driving (outermost thru) lane of each structure. On structures having divided two-way traffic, both driving lanes were investigated. The scope of this investigation covered strip mapping of (a) surface cracking, (b) areas of debonding and/or delaminating, and (c) patching and other signs of visual deterioration. The entire survey area was divided into a (4′ x 3′) grid system. The four foot grid dimensions ran longitudinally with the deck and the three foot dimension ran transverse across the width of the driving lane. In addition, certain limiting length criteria was set up for number and length of survey areas on those structures which were over 300 feet long. See Appendix 1 for details.

On a limited basis, a more comprehensive investigation was conducted on certain selected bridge deck overlays. This additional testing included (a) electrical corrosion potential measurements, (b) composite concrete samples of six sample sites on each deck for chloride ion content analysis, and (c) cores cut over selected surface cracks representing each of three sizes of cracks and referred to as fine, medium and large. For the purpose of this study, size of cracks is defined as follows:

| Type Crack | Description | Can Be Seen From |
|---|---|---|
| Fine | Very Tight | 5′ |
| Medium | Sharp Edged | >5′ |
| Large | Edges Rounded | >5′ |

The field work of the original study was conducted during the fall of 1982 and spring of 1983. The field work on the follow up survey was conducted from the fall of 1989 to the spring of 1990. The same tests were taken as in the original survey except that cores were taken only to confirm either debonding between the deck and overlay or fracture planes within the original deck. As mentioned earlier, the overlay on Bridge A-3521R was replaced, also Bridge A-3664 was opened in November 1983 and both of these are new surveys for the 1989-1990 survey. Bridges L-887R EB and L-887R WB were redecked in 1985 with cathodic protection and were not re-surveyed in 1989-1990. In the following summary, by convention, the 1982-1983 date appears first or is referred to as 1983 data. The 1989-1990 date always follows and is referred to as 1990 data. In all, 91 bridges represented by 104 driving lanes on deck overlays were investigated in 1983, 90 bridges and 102 driving lanes in 1990. Lanes surveyed consisted of 30 latex modified concrete, 9 latex modified mortar, and 65 low slump concrete representing 381,336 square feet of deck area in 1983. There were 27 latex modified concrete, 9 latex modified mortar and 66 low slump concrete decks representing 365,885 square feet in 1990. The original survey covered all the concrete overlays existing in the state in 1983 with the exception of one structure, L-361R1, in the downtown area of St. Louis which was not investigated for safety reasons.

The above overlays were placed on both older rehabilitated structures as well as on structures of

entirely new two course layered construction. In addition, these overlays were placed on decks having seven different superstructure design types. Each of the overlaid structures investigated were grouped under the specific superstructure type. See Table 10.

Missouri has used three different classes of masonry concrete in their bridge deck construction pours. These are Class B-1, B-2, and X respectively. Prior to 1979, nearly all of the deck pours consisted of the Class B-1 masonry mix. However, one of the measures taken in retarding deterioration of reinforcing steel through corrosion, led to modifying the Class B-1 masonry mixture. This modification consisted of lowering the maximum slump requirement of 4 inches for the Class B-1 to 2 1/2 inches for the Class B-2 with an additional slump increase of 1/2 inch permitted by the engineer if needed to improve workability. In addition, the minimum cement requirement for Class A sand was raised from 6.5 sacks as required for the Class B-1 to 7.5 sacks for Class B-2. This modified masonry mixture Class B-2 was first used during the 1979 construction season. It has been since adopted and made a part of Missouri's Standard Specifications for Highway Construction. Beginning in 1981, the majority of our deck structures are built of Class B-2 masonry concrete utilizing epoxy coated reinforcing steel in the top mat and having three inches clear depth of cover. Since 1987, all deck reinforcing steel is epoxy coated. Class X masonry mix is a standard lightweight masonry concrete mix design for bridges having critical deadweight

limitations. Epoxy reinforcing steel and three inches of clear cover over the top bars still applies.

The data from the 1982-1983 study showed that the surface cracking and debonding problem was not widespread as originally feared. The surface cracking and debonding shown by the 1989-1990 survey of these original 90 overlaid bridges has shown some increase in the 6 years since the original study. This is not a significant increase and, at least on these 90 bridges studied, can be attributed to the age of the overlays, most are 9 to 13 years old.

## I. SURFACE CRACKING

The data indicates that 80 percent of these lanes had less than 100 feet of cracking per thousand square feet of deck area, based on an overall weighted average in 1983, it decreased to 45 percent in 1990. This data also indicated that the 1 1/2 inch thick latex concrete had 30 percent less cracking than the two inch low slump concrete, 66 percent in 1990, thus appearing to render a better performance. This was based on a moderate sample size in each case, 22 deck lanes and 21 deck lanes respectively in 1983, 21 and 20 in 1990, and was tabulated from weighted averages. A further performance record as indicated from the weighted average data indicates that the 2 1/4 inch thick low slump concrete had 52 percent more surface cracking than the 2 1/4 inch thick latex concrete in 1983, this increased to 241 percent more in 1990. However, surface cracking in the 2 1/4 inch low slump was significantly less, 65 percent in 1983, than surface cracking in the 2 inch thick low slump concrete. It

was 47 percent less in 1990. Also, the 2 1/4 inch thick low slump concrete had a relatively good sample size representing 42 deck driving lanes in 1983, 43 in 1990, the 2 1/4 inch thick latex concrete had a sample size of only one 1 deck driving lane in both surveys. This data appears to suggest the thicker low slump concrete overlays reduce the surface cracking considerably. It should be pointed out that two of the four decks, Bridges
L-501R and L-642R, that prompted the original study were of the 1 3/4 inch thick low slump concrete. Stripmapping results of the surface cracking on these two structures based on a weighted average, revealed some 408 feet of cracking per thousand square feet of deck area in 1983, 307 feet in 1990. Survey data from exactly the same location showed that cracking was not as visible in the 1989-1990 survey. This was the highest average amount per thickness and type of cracking encountered in the survey. However, this was a very small sample size (2 deck driving lanes) and insufficient to show any kind of trend. This limited data does suggest that the 1 3/4 inch thick low slump concrete may be too thin. In the 1982-1983 survey, the one inch thick latex mortar overlays had a relatively good performance in regard to surface cracking as (90) percent of the grids (4′ x 3′) had none. In the 1989-1990 survey, this had decreased to 48 percent of the grids.

It should be noted here that since the original study and as a result of suggestions in the Implementation section of the first report, only 1 3/4" latex concrete or 2 1/4"

low slump concrete overlays are used by the Missouri Highway and Transportation Department. The latex mortar overlays are no longer used on Missouri bridges.

Based on a weighted average, there was 80 lineal feet of surface cracking per thousand square feet of deck driving lanes in 1983, 206 lineal feet in 1990. Based on this data, 24 or 23.1 percent of the individual 104 surveyed driving lanes exceeded this weighted average in 1983; 28 or 27.5 percent of the 102 driving lanes in 1990.

In the original study, an analysis was made of the following: (a) the various types and thicknesses of overlays versus the seven basic design types of bridge deck superstructures encountered in this study, (b) comparing different classes of concrete utilized in the base deck, i.e., Class B-1 versus Class B-2, (c) comparing eight different associated aggregate combinations utilized in the overlay versus the base deck concrete, and (d) comparing decks of new layered construction and rehabilitated older decks. Results of programs (a), (b), and (c) above indicated no significant difference was found to exist between any of these variables.

A significant difference at the 99 percent level of confidence was found to exist in program (d). This analysis compared design of entirely new construction versus rehabilitated older decks receiving partial half sole and/or full depth area repairs and showed a 73 percent reduction in 1983 in surface cracking for overlays placed on new decks and a 31 percent increase in 1990. The difference between

the 1982-1983 73 percent reduction and 1989-1990, 31 percent increase is explained by the fact that surface cracking increased on the new decks by 241 percent from the original study and on the rehabilitated decks only 28 percent. Table 6 exhibits the results of the surface cracking for each individual deck investigated.

## II. DEBONDING AND/OR DELAMINATION

Results of the overlaid concrete surface debonding and/or delaminating survey, See Table 7, indicated that 84 of the 104 deck driving lanes or 80.8 percent, had no debonding and/or delamination in 1983 compared to 43 of 102 or 42.2 percent in 1990. Some 20 of the 104 deck driving lanes had some percentage of debonding and/or delamination with 6 having greater than 3 percent; in 1990, 59 of 102 had some debonding with 9 over 3 percent. In the 1982-1983 study, four of the six bridges, L-641R, L-642R, L-759R, and A-1763R were rehabilitated decks that had been scarified prior to overlay placement with the remaining two decks, A-3520 and A-3521, of layered new construction. In the 1989-1990 survey, six of the 9 bridges, L-501R, L-641R, L-759R, A-93R, A-119R, and A-1763R were rehabilitated decks with the remaining three decks, A-2225, A-2672, and A-3520, of layered new construction. The bridge exhibiting the largest area was A-2672 which had 31.8 percent of the 1" latex mortar overlay debonded and/or delaminated in 1990. In the 1982-1983 surveys, with one exception, no attempt was made to determine whether a hollow sounding deck area had debonded and/or delaminated.

A debonding problem developed on Bridge A-3520 prior to its being opened to traffic. This bridge was all new construction with B-2 concrete and a latex modified concrete overlay, 12.9 percent of the driving lane had debonded and was patched before opening. At the time of the original survey, an additional 3.1 percent of the driving lane had a hollow sound and was assumed to have debonded. Bridge A-3521 built under the same project had no debonding problem before opening to traffic. However, in the 1982-1983 survey, it was found that 35 percent of its driving lane was debonded. This debonding was verified by drilling cores. Both of these overlays were constructed in 1978 on a non-textured base concrete surface with water blast treatment prior to overlay. Since that time, surface preparation was changed to require a very rough texture by use of a wire comb or scarified. The original overlay placed in 1978 still remains on A-3520 and is providing good service. In the 1989-1990 survey, there was a slight increase in debonding to 5.2 percent. However, Bridge A-3521 was tested in April 1984 and 41.4 percent of the deck was found to be debonded. Subsequently, a project was let and the old overlay removed, the deck scarified and a new overlay placed in August 1984. In May 1989, the new overlay on the bridge, now designated as A-3521R, had zero percent delamination or debonding.

With these few exceptions, debonding and/or delamination has not been a problem to date. Overall, only 0.57 percent of the total 381,336 square feet of overlaid

deck area investigated in 1983 had either debonded and/or delaminated; 1.47 percent of 365,885 square feet in 1990.

## III. PATCHING

Results of the overlaid concrete surface patching survey showed that 96 of the 104 deck driving lanes, or 92.3 percent had no surface patching in 1983 compared to 93 of 102 or 91.2 percent in 1990. Only eight 8 of the 104 deck driving lanes, or 7.7 percent, had any surface patching in 1983, 19 of 102 or 8.8 percent in 1990. Of these 8 deck driving lanes, 6 had less than one percent patching in 1983. There were 19 lanes and 5 had less than one percent patching in 1990. Bridge A-2682 carrying southbound Route 141 traffic with a one inch latex mortar overlay had 1.2 percent patching in 1983, 1.0 percent in 1990. Bridge A-3520 carrying local traffic with a two inch low slump concrete overlay had 12.9 percent patching in 1983, 13.7 percent in 1990. Bridge L-501R had 0 percent patching in 1983, 1.1 percent in 1990. Bridge L-759R had 0 percent patching in 1983, 8.0 percent in 1990. The latter two bridges on Interstate Route 35 had a 1 3/4" low slump concrete and a 1 1/2" latex concrete overlays respectively. See Tables 7 and 7A. Overall, only 0.12 percent of the total 381,336 square feet of overlaid deck area investigated had been patched in 1983, 0.2 percent of 365,885 square feet in 1990.

## IV. ADDITIONAL COMPREHENSIVE TESTING

As mentioned previously, a more comprehensive investigation was conducted on selected bridge deck overlays as follows: (a) 20 deck driving lanes for voltage potential

measurements in 1983, 21 in 1990; (b) 17 deck driving lanes for chloride ion content, 30 in 1990; and (c) 15 deck driving lanes to determine extent of crack penetration in 1983, 7 in 1990.

Reasons for changes in the number of bridges tested in the above studies are:

(a) There was one additional bridge listed in the 1989-1990 survey for voltage potentials because Bridge A-2117 NB and A-2117 SB were each tested separately but in 1982-1983 were reported as representing one lane.

(b) There were 13 additional bridges for which chloride ion content was reported in the 1989-1990 survey. Two twin bridges were counted as single bridges in 1982-1983, A-2117 NB and SB, and A-3547 NB and SB. In the 1989-1990 survey each lane was tested and reported separately making 2 additional test lanes. Twelve additional bridges were sampled for chloride content in the 1989-1990 survey to enhance the data to determine chloride migration. This accounts for the difference of 17 vs. 31.

(c) Twenty-five cores were taken in 1989-1990, 7 of these were to determine the depth of crack penetration with the remaining 18 taken in hollow sounding spots to determine if the overlay was debonding at its interface with the base concrete deck or fracture planed. Generally, this selection was based on (a) broad statewide area representation of

decks with different exposures to varying treatments of deicing materials, (b) varying years of winter exposure of the overlays, and (c) obtaining an approximate representative proportion for each of the three basic type overlays investigated.

A. VOLTAGE POTENTIAL MEASUREMENTS - Table 2 exhibits the results of the copper-copper sulfate half cell voltage potential readings as determined from 6 latex concrete driving lanes in 1983 (6 in 1990), 3 latex mortar driving lanes (3 in 1990), and 11 low slump concrete driving lanes (12 in 1990). These readings were all taken on a (4′ x 3′) control grid system. The results of 4,622 voltage potential readings show that 5 decks that were exposed for 6 winters exhibited the highest percentage of readings recorded in the -0.21 volt to -0.35 volt questionable active or passive range in 1983, of 4751 readings, 5 decks exposed for 12 or 13 winters in 1990. The four rehabilitated older decks having the reported severe surface cracking were all in this group and are L-641R SB, L-642R NB, L-501R SB, and L-759R SB respectively. Also, there were 7 bridges in the 1982-1983 survey and 15 in the 1989-1990 study with voltages greater than -0.35 volts in the active or probable corrosion range. The average percentage of surface area effected per bridge even though it has increased substantially, 0.6 percent in 1982-1983 to 8.6 percent in 1989-1990 remains a relatively small area.

It was stated in the report of the 1982-1983 study that "With the surface cracking present on the above structures,

the effectiveness of these particular overlay systems has largely been destroyed. This then permits the active corrosive environmental area of the base deck concrete to grow ever larger". If this statement had, in fact, come true after the additional six years of exposure, now eight to thirteen winters, the voltage potentials would have shown a much larger increase in the questionable, active or passive range where the increase was only 14.7 percent and in the active corrosion range greater than -0.35V where the increase was 5.8 percent.

B. CHLORIDE CONTENT OF PULVERIZED CONCRETE - As a part of the additional comprehensive testing discussed earlier, concrete samples were taken in 1983 from 17 deck traffic lanes and tested for chloride content, 30 in 1990. Of these 17 decks in 1983, 2 were latex mortar, 6 were latex concrete, and 9 were of low slump concrete. Of the 30 decks in 1990, 4 were latex mortar, 10 latex concrete, and 16 low slump concrete.

A discussion of the sampling procedure, testing, and analysis of results follows.

The chlorides in general had increased moderately in the concrete overlays but little difference was found in the base concrete deck from the 1982-1983 to the 1989-1990 survey. The one exception was A-1763R which is a 1 1/2" latex concrete which had the base deck contaminated already with (2.0 to 3.1) lbs./c.y. in 1982-1983. The overlay chloride content increased slightly but also allowed the base concrete to increase from 2.0 to 2.7 lbs./c.y. at the 2

3/4" to 3 1/4" horizon from the 1982-1983 to the 1989-1990 survey. A 1 3/4" latex concrete overlay was tested in 1989-1990 and chloride content was somewhat lower than in the 1 1/2" latex concrete decks. This was for one deck only with 1 3/4" latex concrete on Bridge L-717R, this deck was not tested for chloride content in 1982-1983.

The four latex mortar overlays, which were all on new two course layered construction contained very high levels of chlorides and had almost doubled since the 1982-1983 survey from 5.5 to 12.7 lbs./c.y. in 1989-1990 in the top of the overlay course. However, these overlays had done a good job keeping the chloride out of the base concrete deck at 0.1 to 1.6 lbs./c.y. concentrations in 1990. Consideration should be given to testing all nine of the latex mortar decks for chloride content and removing the overlays which have high chloride contents such as the four tested in this study and replacing them with 1 3/4" latex concrete or 2 1/4" low slump concrete overlays before the chlorides start to migrate to the base course of concrete and the reinforcing steel.

There was little difference in the chloride content regardless of the thickness of low slump concrete overlays. The chloride content was somewhat higher on the rehabilitated decks than the new two course layered construction decks.

The sampling and testing procedures used in determination of chloride content are as follows: In extracting the concrete samples from the deck, the surface

down to a depth of 1/4 inch was always wasted. Following this, six successive 1/2 inch incremental lifts were made and kept separate to a bottom depth of 3 1/4 inches. Six individual chloride sample sites were chosen in the driving lane in each of the decks tested for chloride content. Samples from the same horizon within the six sample sites were blended together into a composite sample. All overlay thicknesses were penetrated and concrete samples were also taken out of the base concrete. No attempt was made to break a given sample horizon at the overlay-base concrete deck interface because of variations in the overlay thickness. This was especially true on the scarified older rehabilitated decks. All concrete samples were taken by means of a pulverizing (star) bit, worked by a rotary impact hammer. All respective sampling sites were selected away from any surface cracking thus averting any false results from entrapped chlorides. Each of the values shown in Table 3 is the result of composites of six individual samples for each of the successive horizons (a through f) inclusive. The chloride ion content of each of the pulverized concrete samples so blended, was determined by the potentiometric titration method.

Seven of the bridges listed in Table 3 from the 1982-1983 study were rehabilitated older decks and are A-119R,

A-1763R, J-991R, L-501R, L-641R, L-642R, and L-759R with the remaining ten decks of layered new construction. Nine, 9, rehabilitated older bridges were tested for chloride content

in the 1989-1990 survey. L-319R and L-717R were added to these tests in 1989-1990. A-3521R, which appears in Table 3A, is actually of layered new construction, in 1984 it had the 2" overlay removed and a new 2 1/4" low slump overlay placed. Based on the results of the chloride content found in the concrete samples taken in the 1982-1983 investigations, 8 of the 17 decks tested had chloride content of two pounds or greater near the surface of the overlay. In 1989-1990, 17 of 30 decks tested were at two pounds or more. The data from both 1982-1983 and 1989-1990 indicates that the latex modified concrete and latex mortar overlays have high chloride ion content while the low slump concrete generally does not. The exception being the two 1 3/4 inch thick low slump concrete decks, L-501R and L-642R tested in 1982-1983. In the 1989-1990 survey on the above two bridges, the tests showed a slight decrease in chloride content. The latex concrete overlays all increased slightly and the latex mortar overlays practically doubled.

Results indicate that the overlays have protected the base concrete deck against the migration of chloride ions. Bridge L-759R, having a 1 1/2 inch thick latex concrete overlay, had 222 lineal feet of cracking per 1,000 square feet of deck area in 1983 and 679 lineal feet in 1990 which may account for the high chloride content reported.

A rather unusual set of chloride results were obtained from Bridge A-3623 in the 1982-1983 study. The chloride content consistently remained moderately high in all of the sampled base concrete horizons. A possible explanation

could be that the aggregate or admixture had a higher base chloride content level relative to the others. This was not the case in data from the 1989-1990 tests. This structure lies between the 200 to 300 mean freezing index contours in the southern portion of the state. As such, it should not have been subjected to significantly high chloride exposure. See Figure 1. This bridge was built in 1979 and exposed through only four winters before the 1982-1983 survey. A possible explanation for the decrease of chlorides in the base concrete noted in the 1989-1990 survey is because the chlorides have migrated deeper and are now more uniform. Also, the 1 1/2" latex concrete overlay has not allowed penetration of chloride ions through to the base concrete. This deck has now had 12 winter exposures and the average chloride content of the base concrete is only 0.8 lbs./c.y.

When comparing the chloride content of the 10 all new constructed decks with the 7 rehabilitated decks in 1983, 21 new and 9 rehabilitated in 1990, the top 1/4" to 3/4" horizon of the overlay regardless of years of winter exposure and types of overlay revealed the following in the 1982-1983 survey vs. the 1989-1990 survey. There was in 1983 an average of 1.75 pounds of chloride per cubic yard of concrete (new decks) versus 3.09 pounds of chloride per cubic yard of concrete (rehabilitated decks) or 77 percent more chlorides present in the overlay concrete taken from the rehabilitated decks than the new decks. There was, in the 1982-1983 survey, no satisfactory explanation for this observation. There was in 1990 an average of 3.32 pounds

of chloride per cubic yard of concrete (new decks) versus 3.31 pounds of chloride per cubic yard of concrete (rehabilitated decks) or 0.3 percent less chlorides present in the overlay concrete taken from the rehabilitated decks than the new decks. After 9-13 winter exposures, the 1989-1990 survey showed there is no correlation between chloride content of new and rehabilitated decks within the overlay layer.

C. CRACK PENETRATION - Concern for the depth of crack penetration with respect to variation in crack widths resulted in drilling and obtaining a total of 81 four inch diameter cores in 1983, 25 in 1990. Cores were generally taken from the bridge decks that had been chosen for additional testing. Appendix I contains pairs of photographs that exhibit both a plan (top) and profile (side) view of the 1989-1990 cores. These photos document various sizes of cracks that were cored and the associated depth of crack penetration. Of the 81 cores that were cut for crack studies, 6 were extracted from an overlay of latex mortar, 21 cores were extracted from overlays of latex concrete, and the remaining 54 cores were extracted from overlays of low slump concrete in 1983. Of 25 cores taken in 1990, 1 was latex mortar, 7 latex concrete, and 17 low slump concrete.

It should be noted that in the 1989-1990 survey, the cores were taken only in hollow sounding areas to verify if the overlay was debonded. An attempt was made to take cores over cracks in these areas where possible.

It became apparent after examining the 81 cores taken in 1982-1983 that one could not realistically determine the depth of penetration from any surface crack width observations. Fine cracks that appeared superficial on the surface, oftentimes penetrated through the entire overlay thickness and extended into the base concrete deck. Several large surface cracks exhibited very shallow penetration into the overlay while others did extend through the entire overlay thickness and continued on into the base concrete deck.

Any concrete overlay cracks, however, regardless of penetration depth, are a concern, and should be considered detrimental as they permit ready access of deicing salts down through the protective overlay system. The downward migrating chloride ions, now having penetrated the protective overlay barrier, via the cracks, have premature access into the base concrete mass, thus are assumed to have reduced the design life of the overlay. It was stated in the original 1984 report that "This has for all practical purposes destroyed the design effect of the overlay system itself."

Analysis of the 1989-1990 survey data, indicate this statement does not appear to be correct. The overlays have considerably slowed the ingress of chlorides to the base concrete deck. Even in the latex mortar overlays which in 1990 had a high of 12.9 lbs./c.y. in the top half inch in one overlay and averaged 6.9 lbs./c.y. for the four decks tested, the highest chloride content found in the base

concrete deck on a rehabilitated bridge, A-1763R, was 3.1 lbs./c.y., the same in June 1989 as it was in October 1982. The highest chloride content found in the base concrete deck of a layered new concrete deck was 1.2 lbs./c.y. on Bridge A-3623 in the 1982-1983 survey at all horizons.
In 1989-1990, the highest was 2.3 lbs./c.y. on Bridge A-3085 and was in the first 1/2 inch horizon of the base concrete. The next two 1/2" horizons indicated chloride content of 1.6 and 0.8 lbs./c.y. respectively.

In the 1982-1983 survey, 27 percent or 22 of the 81 cores drilled from 15 bridge decks exhibited surface cracks extending through the overlay and into the base concrete deck. In the 1989-1990 survey, 12.5 percent or 1 of 8 cores drilled from 7 bridge decks exhibited surface cracks extending through into the base deck. The entire series of drilled cores were obtained at random over the various widths and types of cracks defined earlier. This demonstrates the variability of the crack depth of penetration, regardless of the crack width.

All cores were obtained from debonded and/or delaminated areas in the 1989-1990 study. Therefore, comparing of the overlay can best be done from the soundings. Overall in the debonding, square feet debonded over total square feet tested, went from 0.6% in 1982-1983 to 1.0% in 1989-1990. With respect to various types of overlay systems, there was 0.7 percent of the area debonded on latex concrete in 1983 and 3.2 percent in 1990. In 1983, 0.5 debonded on low slump concrete and 0.4 percent in 1990.

In 1983, 0.03 percent was debonded on latex mortar overlays and 0.8 percent in 1990. From the cores taken in the 1989-1990 study, the one crack that extended into the base concrete deck extended to the bottom of the core and the core was fracture planed at the level of the reinforcing steel. The bond between the base concrete and latex overlay mortar was good. Also, in the 1989-1990 survey, 2 of the 6 fracture planes found were in patched areas of the base concrete deck.

A total of 70 of 81, or 86.4 percent of the cores drilled in 1982-1983 and 24 of 25, or 96 percent of cores drilled in 1989-1990 showed overlay thicknesses equal to or greater than the specified design thickness called for on the plans.

## SUMMARY

Surface cracking was not found to be a problem as initially thought. Some 95 percent of 31,778 grids surveyed (4′ x 3′) had no surface cracking or less than five lineal feet of surface cracking per grid in 1983. This compared with 82 percent of 31,281 grids in 1990.

Debonding and/or delamination problems of any significance were generally confined to 6 of 104 bridge deck driving lanes in 1983 and only 7 of 102 in 1990.

Patching of the overlays of any significance was confined to only 1 of 104 bridge deck driving lanes in 1983 and 2 of 102 in 1990.

Of 4,622 voltage potential readings taken on 20 driving lanes showed, only 28 readings or 0.6 percent were found to be in the active or probable corrosion range of greater than -0.35 volts in 1983. In 1990, of 4,751 voltage potential readings taken, only 295 readings or 6.2 percent were greater than -0.35 volts. In 1983, concrete samples were taken for chloride analysis in 17 decks ranging from three through six winters of exposure.

Results of chloride analysis of concrete samples taken in 1990 from 30 decks ranging from nine to thirteen winters of exposure indicated generally the overlays were protecting the base deck from the migration of chloride ions. Four of nine 1" latex mortar overlays were tested where the chloride content in the overlay doubled from the 1982-1983 survey to the 1989-1990 survey. One of the overlays contained 12.9

lbs. of chloride per cubic yard at the top 1/2" lift sample, i.e., the 1/4" to 3/4" horizon. So far, the chloride level in the base concrete deck on these bridges has remained low.

Generally, these overlay systems have performed well. Those tested in this survey have been through 9 to 13 winters of exposure. Cracking, debonding, patching, half cell potentials, and chloride content have only moderately increased. The one red flag which has popped up is the chloride content within the latex mortar overlays. These decks should continue to be monitored and the overlay systems replaced before the high level of chlorides reach the base concrete decks. One of the latex mortar overlays should be removed now and the other eight within about five years. This translates into a 14 to 19 year life span for these thin 1" overlays. The remaining 80 bridges which were the first latex and low slump overlays placed in Missouri should at the present rate of deterioration last at least another 10 years which would give them a 20-25 year life span. In the past several construction seasons, 1984 through 1989, a few isolated overlays have shown considerable surface cracking. Eighty-nine (89) original bridges with overlays have now been surveyed twice, in 1982-1983 and 1989-1990, and have performed well. It is possible that the placement procedures for construction of concrete overlays and not the material or mix design is responsible for the recent problems with surface cracking.

The primary cause for plastic shrinkage cracking is poor curing of the concrete. Given the likelihood that the construction of overlays on bridge decks will continue into the foreseeable future a study of our curing specifications would appear to be warranted as soon as possible.

Table 1

SUMMARY OF CRACKING IN OVERLAYS BY TYPE AND THICKNESS

| Thickness and Type of Overlays | Number Of Overlays | No. of Grid Squares | By (4 x 3)' Grid Squares (Weighted Average): No Cracking Clear Grids (%) | (>0 to ≤5) Feet (%) | (>5 to ≤10) Feet (%) | (>10 to ≤15) Feet (%) | >15 Feet (%) | Cracking Per 1000 Sq.Ft. |
|---|---|---|---|---|---|---|---|---|
| 1" Min. Latex Concrete | 2 | 792 | 35.2 | 50.5 | 13.3 | 1.0 | 0 | 226 |
| 1 1/2" Latex Concrete | 22 | 5,024 | 72.1 | 23.0 | 4.5 | 0.4 | 0 | 92 |
| 1 3/4" Latex Concrete | 2 | 240 | 93.8 | 6.2 | 0 | 0 | 0 | 16 |
| 1 3/4-2" Latex Concrete | 1 | 336 | 93.4 | 6.6 | 0 | 0 | 0 | 17 |
| 2" Latex Concrete | 2 | 464 | 91.4 | 8.6 | 0 | 0 | 0 | 22 |
| 2 1/4" Latex Concrete | 1 | 216 | 91.2 | 8.8 | 0 | 0 | 0 | 22 |
| 1" Latex Mortar | 9 | 1,416 | 89.7 | 9.8 | 0.5 | 0 | 0 | 28 |
| 1 3/4" Low Slump | 2 | 351 | 8.3 | 51.3 | 37.3 | 3.1 | 0 | 408 |
| 2" Low Slump | 21 | 8,441 | 72.4 | 15.1 | 9.8 | 2.4 | 0.3 | 132 |
| 2 1/4" Low Slump | 42 | 14,498 | 84.0 | 14.6 | 1.3 | 0.1 | 0 | 46 |
| All Overlays: | 104 | 31,778 | 77.7 | 17.1 | 4.4 | 0.7 | 0.1 | 80 |

General:

The above represents 381,336 square feet of driving (traffic) lane deck area investigated.
See Photographs of Various Crack Density Lineal Surface Cracking, Appendix, pg. "g" through "j".

## Table 1A
## 1989 - 1990 Survey
## SUMMARY OF CRACKING IN OVERLAYS BY TYPE AND THICKNESS

| | | | | By (4 x 3)' Grid Squares (Weighted Average) | | | | |
|---|---|---|---|---|---|---|---|---|
| Thickness and Type of Overlays | Number of Overlays | No. of Grid Squares | No Cracking Clear Grids (%) | (>0 to ≤5) Feet (%) | (>5 to <10) Feet (%) | (>10 to <15) Feet (%) | >15 Feet (%) | Cracking Per 1000 Sq.Ft. |
| 1" Min. latex Concrete (1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 1/2" Latex Concrete | 21 | 4,823 | 39.5 | 31.0 | 7.9 | 1.5 | 0.1 | 137 |
| 1 3/4" Latex Concrete | 2 | 779 | 18.8 | 3.3 | 0 | 0 | 0 | 85 |
| 1 3/4-2" Latex Concrete | 1 | 336 | 74.1 | 25.3 | 0.6 | 0 | 0 | 59 |
| 2" Latex Concrete | 2 | 464 | 75.2 | 21.3 | 3.5 | 0 | 0 | 67 |
| 2 1/4" Latex Concrete | 1 | 216 | 76.9 | 23.1 | 0 | 0 | 0 | 47 |
| 1" Latex Mortar | 9 | 1,416 | 64.5 | 25.5 | 8.9 | 1.0 | 0.1 | 112 |
| 1 3/4" Low Slump | 2 | 353 | 10.6 | 68.7 | 19.7 | 1.0 | 0 | 307 |
| 2" Low Slump | 20 | 7,282 | 27.6 | 33.0 | 24.9 | 11.3 | 3.2 | 393 |
| 2 1/4" Low Slump | 44 | 16,151 | 50.8 | 36.4 | 9.8 | 1.0 | 2.0 | 163 |
| All Overlays: | 102 | 31,281 | 48.6 | 34.6 | 12.0 | 3.2 | 1.6 | 208 |

(1) Bridges L-887R EB and L-887R WB were redecked with Cathodic Protection in 1985 and therefore not surveyed in 1989-90.

General:

The above represents 365,885 square feet of driving (traffic) lane deck area investigated.
See Photographs of Various Crack Density Lineal Surface Cracking, Apppendix, pg. "h" through "k".

Table 2

1982-1983 Survey

COPPER-COPPER SULFATE HALF CELL POTENTIAL READINGS

| Bridge No. & Direction | Type of Overlay | Winter Exposures | No. of Readings | Voltage Readings - Percent Of By Categories 0 to -0.20V | -0.21 to -0.35V | >-0.35V |
|---|---|---|---|---|---|---|
| A-1763R E.B. | 1 1/2" Latex Concrete | 3 | 420 | 91.5 | 8.3 | 0.2 |
| A-3623 W.B. | 1 1/2" Latex Concrete | 3 | 232 | 91.4 | 8.6 | 0 |
| A-3810 O.R. | 1 1/2" Latex Concrete | 4 | 198 | 97.5 | 2.5 | 0 |
| J-991R W.B. | 1 1/2" Latex Concrete | 5 | 228 | 99.6 | 0.4 | 0 |
| L-641R S.B. | 1 1/2" Latex Concrete | 6 | 183 | 43.2 | 53.0 | 3.8 |
| L-759R S.B. | 1 1/2" Latex Concrete | 6 | 198 | 79.3 | 20.7 | 0 |
| A-2672 N.B. | 1" Latex Mortar | 4 | 225 | 100 | 0 | 0 |
| A-2672 S.B. | 1" Latex Mortar | 4 | 230 | 100 | 0 | 0 |
| A-2738 S.B. | 1" Latex Mortar | 6 | 248 | 62.9 | 34.7 | 2.4 |
| A-3830 E.B. | 2" Low Slump | 2 | 164 | 98.8 | 1.2 | 0 |
| A-2117 N.B. | 2 1/4" Low Slump | 2 | 256 | 100 | 0 | 0 |
| A-2117 S.B. | 2 1/4" Low Slump | 2 | 256 | 99.2 | 0.8 | 0 |
| A-119R E.B. | 2" Low Slump | 3 | 184 | 95.7 | 4.3 | 0 |
| A-3547 N.B. | 2 1/4" Low Slump | 3 | 240 | 97.9 | 2.1 | 0 |
| A-3547 S.B. | 2 1/4" Low Slump | 3 | 240 | 97.9 | 2.1 | 0 |
| A-3617 S.B. | 2 1/4" Low Slump | 3 | 283 | 100 | 0 | 0 |
| A-3521 E.B. | 2" Low Slump | 4 | 272 | 94.2 | 5.1 | 0.7 |
| A-3522 E.B. | 2" Low Slump | 4 | 163 | 99.4 | 0.6 | 0 |
| L-501R S.B. | 1 3/4" Low Slump | 6 | 255 | 78.8 | 18.4 | 2.8 |
| L-642R N.B. | 1 3/4" Low Slump | 6 | 147 | 73.5 | 23.1 | 3.4 |
| | TOTALS | | 4,622 | 90.7 | 8.7 | 0.6 |

R=Rehabilitated Bridge Deck

O.R.=Outer Roadway

| | Type of Overlays | | |
|---|---|---|---|
| | Low Slump Concrete | Latex Concrete | Latex Mortar |
| Total Lanes Surveyed: | 11 | 6 | 3 |

Table 2A
1989-1990 Survey
**COPPER-COPPER SULFATE HALF CELL POTENTIAL READINGS**

| Bridge No. & Direction | Type of Overlay | Winter Exposures | No. of Readings | Voltage Readings - Percent Of By Categories 0 to -0.20V | -0.21 to -0.35V | >-0.35V |
|---|---|---|---|---|---|---|
| A-1763R RAMP | 1 1/2" Latex Concrete | 10 | 420 | 71.0 | 18.3 | 10.7 |
| A-3623 W.B. | 1 1/2" Latex Concrete | 10 | 232 | 33.6 | 59.5 | 6.9 |
| A-3810 O.R. EB | 1 1/2" Latex Concrete | 11 | 198 | 94.0 | 5.5 | 0.5 |
| J-0991R W.B. | 1 1/2" Latex Concrete | 13 | 228 | 92.5 | 7.5 | 0.0 |
| L-0641R S.B. | 1 1/2" Latex Concrete | 12 | 148 | 25.7 | 56.8 | 17.5 |
| L-0759R S.B. | 1 1/2" Latex Concrete | 12 | 133 | 4.5 | 66.2 | 29.3 |
| A-2672 N.B. | 1" Latex Mortar | 12 | 225 | 80.1 | 18.2 | 1.7 |
| A-2672 S.B. | 1" Latex Mortar | 12 | 227 | 86.3 | 11.9 | 1.8 |
| A-2738 S.B. | 1" Latex Mortar | 13 | 248 | 7.6 | 65.8 | 26.6 |
| A-3830 E.B. | 2" Low Slump | 9 | 164 | 96.3 | 3.7 | 0.0 |
| A-2117 N.B. | 2 1/4" Low Slump | 9 | 256 | 83.7 | 14.0 | 2.3 |
| A-2117 S.B. | 2 1/4" Low Slump | 9 | 256 | 78.2 | 17.9 | 3.9 |
| A-0119R E.B. | 2" Low Slump | 10 | 184 | 96.3 | 3.7 | 0.0 |
| A-3547 N.B. | 2 1/4" Low Slump | 11 | 240 | 75.5 | 19.5 | 5.0 |
| A-3547 S.B. | 2 1/4" Low Slump | 11 | 240 | 0.0 | 84.5 | 15.5 |
| A-3617 S.B. | 2 1/4" Low Slump | 10 | 283 | 100.0 | 0.0 | 0.0 |
| A-3617 N.B.(1) | 2 1/4" Low Slump | 10 | 283 | 100.0 | 0.0 | 0.0 |
| A-3521R S.B.(EB)* | 2 1/4" Low Slump | 5 | 272 | 89.4 | 5.5 | 5.1 |
| A-3522 E.B. | 2" Low Slump | 12 | 163 | 96.9 | 3.1 | 0.0 |
| L-0501R S.B. | 1 3/4" Low Slump | 12 | 204 | 72.5 | 22.1 | 5.4 |
| L-0642R N.B. | 1 3/4" Low Slump | 12 | 147 | 78.9 | 17.7 | 3.4 |
| | TOTALS | | 4,751 | 71.0 | 22.8 | 6.2 |

R=Rehabilitated Bridge Deck
OR=Outer Roadway

| | Type of Overlays: Low Slump Concrete | Latex Concrete | Latex Mortar |
|---|---|---|---|
| Total Lanes Surveyed | 12 | 6 | 3 |

(1) This bridge not tested in 1982-1983 survey.
* In 1984 Bridge A-3521R had the 2" overlay removed and a new 2 1/4" Low Slump overlay placed.

Table 3

1982-1983 Survey

CHLORIDE CONTENT OF PULVERIZED CONCRETE

| Bridge No. & Direction | Thickness and Type Of Overlay | Winter Exposures | Chloride Content in Pounds Per Cubic Yard of Concrete For Depth Indicated: 1/4" to 3/4" | 3/4" to 1 1/4" | 1 1/4" to 1 3/4" | 1 3/4" to 2 1/4" | 2 1/4" to 2 3/4" | 2 3/4" to 3 1/4" |
|---|---|---|---|---|---|---|---|---|
| A-1763R N & SB | 1 1/2" Latex Concrete | 4 | 1.2 | 0.4 | 1.6 | 3.1 | 2.7 | 2.0 |
| A-3623 W.B. | 1 1/2" Latex Concrete | 4 | 2.0 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| A-3810 O.R. | 1 1/2" Latex Concrete | 5 | 0.7 | 0.2 | 0.2 | 0.3 | 0.3 | 0.2 |
| J-991R W.B. | 1 1/2" Latex Concrete | 6 | 3.5 | 1.6 | 0.5 | 0.4 | 0.2 | 0.2 |
| L-641R S.B. | 1 1/2" Latex Concrete | 6 | 3.4 | 0.6 | 0.2 | 0.6 | 0.9 | 0.8 |
| L-759R S.B. | 1 1/2" Latex Concrete | 6 | 7.4 | 3.1 | 2.0 | 2.0 | 1.6 | 1.2 |
| A-2672 S.B. | 1" Latex Mortar | 6 | 4.3 | 1.2 | 0.3 | 0.3 | 0.2 | 0.1 |
| A-2738 S.B. | 1" Latex Mortar | 6 | 7.8 | 2.0 | 0.3 | 0.1 | 0.2 | 0.2 |
| L-501R S.B. | 1 3/4" Low Slump | 6 | 2.3 | 0.6 | 0.3 | 0.6 | 1.2 | 0.8 |
| L-642R N.B. | 1 3/4" Low Slump | 6 | 3.1 | 0.6 | 0.2 | 0.1 | 0.6 | 0.6 |
| A-3830 E.B. | 2" Low Slump | 3 | 1.2 | 0.8 | 0.7 | 0.5 | 0.4 | 0.2 |
| A-119R E.B. | 2" Low Slump | 4 | 0.7 | 0.6 | 0.5 | 0.4 | 0.5 | 0.5 |
| A-3521 E.B. | 2" Low Slump | 5 | 0.2 | 0.2 | 0.2 | 0.4 | 0.3 | 0.2 |
| A-3522 E.B. | 2" Low Slump | 5 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| A-2117 N & SB | 2 1/4" Low Slump | 3 | 0.4 | 0.2 | 0.3 | 0.3 | 0.2 | 0.3 |
| A-3617 S.B. | 2 1/4" Low Slump | 3 | 0.4 | 0.2 | 0.2 | 0.3 | 0.3 | 0.4 |
| A-3547 N & SB | 2 1/4" Low Slump | 4 | 0.3 | 0.2 | 0.2 | 0.3 | 0.4 | 0.3 |

R=Rehabilitated Bridge Deck
O.R.=Outer Roadway

| | Type of Overlays: Low Slump Concrete | Latex Concrete | Latex Mortar |
|---|---|---|---|
| Total Lanes Tested | 9 | 6 | 2 |

Utilized 3,900 #/yd.$^3$ as a base concrete unit weight.

Table 3A
1989-1990 Survey
**CHLORIDE CONTENT OF PULVERIZED CONCRETE**

| Bridge No. & Direction | Thickness and Type of Overlay | Winter Exposures | Chloride Content in Pounds Per Cubic Yard of Concrete For Depth Indicated: 1/4" to 3/4" | 3/4" to 1 1/4" | 1 1/4" to 1 3/4" | 1 3/4" to 2 1/4" | 2 1/4" to 2 3/4" | 2 3/4" to 3 1/4" |
|---|---|---|---|---|---|---|---|---|
| A-1763R RAMP | 1 1/2" Latex Concrete | 10 | 3.1 | 0.5 | 0.8 | 2.3 | 3.1 | 2.7 |
| A-3623 W.B. | 1 1/2" Latex Concrete | 10 | 4.3 | 2.0 | 0.8 | 0.8 | 0.5 | 0.8 |
| A-3810 O.R. EB | 1 1/2" Latex Concrete | 11 | 1.2 | 0.8 | 0.8 | 0.8 | 1.6 | 0.8 |
| J-991R W.B. | 1 1/2" Latex Concrete | 13 | 5.9 | 2.7 | 1.6 | 0.4 | 0.2 | 0.0 |
| L-641R S.B. | 1 1/2" Latex Concrete | 12 | 3.1 | 1.2 | 0.8 | 1.2 | 2.0 | 1.6 |
| L-759R S.B. | 1 1/2" Latex Concrete | 12 | 4.7 | 2.7 | 3.5 | 2.7 | 2.0 | 1.6 |
| A-2672 S.B. | 1" Latex Mortar | 12 | 7.8 | 3.5 | 1.6 | 0.8 | 0.6 | 0.4 |
| A-2738 S.B. | 1" Latex Mortar | 13 | 12.9 | 5.5 | 1.2 | 0.2 | 0.1 | 0.1 |
| L-501R S.B. | 1 3/4" Low Slump | 12 | 1.6 | 0.8 | 0.8 | 1.2 | 0.8 | 0.8 |
| L-642R N.B. | 1 3/4" Low Slump | 12 | 2.3 | 0.5 | 0.3 | 0.3 | 0.5 | 0.8 |
| A-3830 E.B. | 2" Low Slump | 9 | 1.2 | 0.8 | 0.5 | 0.3 | 0.3 | 0.2 |
| A-119R E.B. | 2" Low Slump | 10 | 2.1 | 0.2 | 0.8 | 1.2 | 0.8 | 0.8 |
| **A-3521R S.B.**[1] | **2 1/4" Low Slump** | **5** | **0.5** | **0.4** | **0.3** | **0.4** | **0.1** | **0.2** |
| A-3522 E.B. | 2" Low Slump | 12 | 0.3 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 |
| A-2117 N.& SB | 2 1/4" Low Slump | 9 | 2.0 | 0.6 | 0.4 | 0.3 | 0.2 | 0.2 |
| A-3617 S.B. | 2 1/4" Low Slump | 10 | 0.8 | 0.4 | 0.2 | 0.2 | 0.2 | 0.2 |
| A-3547 N.B. | 2 1/4" Low Slump | 11 | 1.6 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 |
| A-3547 S.B. | 2 1/4" Low Slump | 11 | 1.6 | 0.8 | 0.8 | 0.8 | 0.8 | 1.2 |
| **A-3085 S.B.**[2] | **1 1/2" Latex Concrete** | **11** | **4.7** | **2.3** | **2.0** | **2.3** | **1.6** | **0.8** |
| **A-3735 RAMP** | **1 1/2" Latex Concrete** | **11** | **2.7** | **2.0** | **1.6** | **1.6** | **0.8** | **0.2** |
| **L-717R W.B.** | **1 3/4" Latex Concrete** | **10** | **3.9** | **0.5** | **0.1** | **1.2** | **1.6** | **1.6** |
| **A-3004 E.B.** | **2 1/4" Latex Concrete** | **10** | **3.9** | **0.8** | **0.2** | **0.2** | **0.2** | **0.2** |
| **A-2682 S.B.** | **1" Latex Mortar** | **13** | **4.7** | **2.7** | **2.0** | **1.6** | **1.2** | **0.8** |
| **A-2683 S.B.** | **1" Latex Mortar** | **13** | **2.3** | **0.8** | **0.5** | **0.4** | **0.2** | **0.2** |
| **L-319R E.B.** | **2" Low Slump** | **9** | **3.1** | **0.8** | **0.3** | **0.3** | **0.0** | **0.2** |
| **A-2132 N.B.** | **2 1/4" Low Slump** | **9** | **5.1** | **1.2** | **0.3** | **0.3** | **0.4** | **0.3** |
| **A-2225 N.B.** | **2 1/4" Low Slump** | **8** | **3.5** | **0.8** | **0.2** | **0.2** | **0.3** | **0.2** |
| **A-2225 S.B.** | **2 1/4" Low Slump** | **8** | **4.3** | **0.2** | **0.2** | **0.2** | **0.3** | **0.3** |
| **A-3128** | **2 1/4" Low Slump** | **11** | **2.0** | **0.5** | **0.3** | **0.2** | **0.2** | **0.2** |
| **A-3352 RAMP** | **2 1/4" Low Slump** | **12** | **2.3** | **1.2** | **0.8** | **0.8** | **1.2** | **1.2** |

R=Rehabilitated Bridge Deck
O.R.=Outer Roadway

| | Type of Overlays: Low Slump Concrete | Latex Concrete | Latex Mortar |
|---|---|---|---|
| Total Lanes Tested | 16 | 10 | 4 |

(1) In 1984 Bridge A-3521R had the 2" overlay removed and a new 2 1/2" Low Slump overlay placed.
(2) Bridges in bold type were additional in 1989-90 and were not tested for chlorides in 1982-83.
Utilized 3,900 #/yd.$^3$ as a base concrete unit weight.

Table 4
1982-1983 Survey
SUMMARY OF DEBONDING AND/OR DELAMINATION
AND PATCHING IN OVERLAYS BY TYPE AND THICKNESS

| Thickness and Type of Overlays | Surveyed Area Sq.Ft. | (1)Debonded Area Sq.Ft. | (1)Debonded Area % | Patching Area Sq.Ft. | Patching Area % |
|---|---|---|---|---|---|
| 1" Min. Latex Concrete | 9,504 | 194 | 2.0 | 0 | 0 |
| 1 1/2" Latex Concrete | 60,288 | 479 | 0.8 | 11 | * |
| 1 3/4" Latex Concrete | 2,880 | 7 | 0.2 | 0 | 0 |
| 1 3/4-2" Latex Concrete | 4,032 | 1 | * | 0 | 0 |
| 2" Latex Concrete | 5,568 | 3 | 0.1 | 0 | 0 |
| 2 1/4" Latex Concrete | 2,592 | 0 | 0 | 0 | 0 |
| 1" Latex Mortar | 16,992 | 5 | * | 14 | 0.1 |
| 1 3/4" Low Slump Concrete | 4,212 | 159 | 3.8 | 0 | 0 |
| 2" Low Slump Concrete | 101,292 | 1,253 | 1.2 | 415 | 0.4 |
| 2 1/4" Low Slump Concrete | 173,976 | 45 | * | 30 | * |
| TOTALS: | 381,336 | 2,146 | 0.6 | 470 | 0.1 |

(1) Sounded by combination of chain drag and steel rod.
*Values are less than 0.06%.

**Table 4A**
**1989-1990 Survey**
**SUMMARY OF DEBONDING AND/OR DELAMINATION**
**AND PATCHING IN OVERLAYS BY TYPE AND THICKNESS**

| Thickness and Type of Overlays | Surveyed Area Sq.Ft. | (1) Debonded Area Sq.Ft. | (1) Debonded Area % | Patching Area Sq.Ft. | Patching Area % |
|---|---|---|---|---|---|
| 1" Min. Latex Concrete (2) | 0 | 0 | 0 | 0 | 0 |
| 1 1/2" Latex Concrete | 57,606 | 2,284 | 4.0 | 138 | 0.2 |
| 1 3/4" Latex Concrete | 2,880 | 7 | 0.2 | 0 | 0 |
| 1 3/4-2" Latex Concrete | 3,948 | 24 | 0.8 | 0 | 0 |
| 2" Latex Concrete | 5,568 | 27 | 0.5 | 0 | 0 |
| 2 1/4" Latex Concrete | 2,592 | 2 | 0.1 | 0 | 0 |
| 1" Latex Mortar | 16,896 | 143 | 0.8 | 12 | 0.1 |
| 1 3/4" Low Slump Concrete | 4,272 | 261 | 6.1 | 27 | 0.6 |
| 2" Low Slump Concrete | 84,407 | 338 | 0.6 | 432 | 0.5 |
| 2 1/4" Low Slump Concrete | 187,716 | 560 | 0.3 | 216 | 0.1 |
| TOTALS: | 365,885 | 3,648 | 1.0 | 825 | 0.2 |

(1) Sounded by steel rod.
(2) Bridges L-887R EB and L-887R WB were redecked with Cathodic Protection in 1985 and therefore not surveyed in 1989-90.

Table 5

1982-1983 Survey
SUMMARY OF CORE DATA ON CRACK PENETRATION

| Type of Overlay | No. of Cores | Surface Crack Penetrate Substrate Base Concrete Yes (%) | No (%) |
|---|---|---|---|
| All cores As A Group | 81 | 27.2 | 72.8 |
| Latex Modified Mortar | 6 | 50.0 | 50.0 |
| Latex Modified Concrete | 21 | 14.3 | 85.7 |
| Low Slump Concrete | 54 | 29.6 | 70.4 |
| **Type of Deck** | | | |
| Newly Constructed | 68 | 32.4 | 67.6 |
| Rehabilitated | 13 | 0 | 100.00 |
| TOTAL: | 81 | | |

General: Of the 81 cores drilled, eight cores had no bond between the overlay and the base concrete deck. On those eight cores having no bond, five were drilled from one deck Bridge A-3521 on Route AC in Callaway County.

**Table 5A**
**1989-1990 Survey**
**SUMMARY OF CORE DATA ON CRACK PENETRATION**

| Type of Overlay | No. of Cores | Surface Crack Penetrate Substrate Base Concrete Yes (%) | No (%) |
|---|---|---|---|
| All Cores As A Group | 25 | 12.0 | 88.0 |
| Latex Modified Mortar | 1 | 0.0 | 100.0 |
| Latex Modified Concrete | 11 | 9.1 | 90.9 |
| Low Slump Concrete | 13 | 15.4 | 84.6 |
| **Type of Deck** | | | |
| Newly Constructed | 10 | 0.0 | 100.0 |
| Rehabilitated | 15 | 33.3 | 66.6 |
| TOTAL: | 25 | | |

General: Of the 25 cores drilled, twenty cores had no bond between the overlay and the base concrete deck. On those twenty cores having no bond three were also fracture planed in the base deck concrete at the level of the top reinforcing steel. (It should be noted that in the 1989-90 Survey the cores were taken primarily in hollow areas to determine whether Debonded or Fracture Planed.)

* In 1984 Bridge A-3521R had the 2" overlay removed as it was nearly all debonded and a new 2 1/4" Low Slump overlay placed.

Table 6
1982-1983 Survey
LINEAL SURFACE CRACKING IN OVERLAYS

| Bridge No. & Direction | Type of Structure | Depth and Type of Overlay | No. of Grid Squares | By (4 x 3)' Grid Squares: No Cracking, Clear Grids (%) | (>0 to ≤5) Feet (%) | (>5 to ≤10) Feet (%) | (>10 to ≤15) Feet (%) | >15 Feet (%) | Cracking Per 1,000 Sq.Ft. |
|---|---|---|---|---|---|---|---|---|---|
| L-887R W.B. | BB-G | 1" Min. Latex Concrete | 396 | 31.5 | 51.8 | 15.9 | 0.8 | 0 | 244 |
| L-887R E.B. | BB-G | 1" Min. Latex Concrete | 396 | 38.9 | 49.2 | 10.6 | 1.3 | 0 | 207 |
| A-93R W.B. | BB-G | 1 1/2" Latex Concrete (+) | 252 | 78.6 | 19.8 | 1.6 | 0 | 0 | 61 |
| A-93R E.B. | BB-G | 1 1/2" Latex Concrete (+) | 252 | 94.0 | 6.0 | 0 | 0 | 0 | 15 |
| A-1310R W.B. | STRG | 1 1/2" Latex Concrete | 208 | 71.6 | 28.4 | 0 | 0 | 0 | 71 |
| A-1310R E.B. | STRG | 1 1/2" Latex Concrete | 208 | 84.6 | 15.4 | 0 | 0 | 0 | 39 |
| A-1643R W.B. | BB-G | 1 1/2" Latex Concrete | 244 | 30.6 | 56.8 | 12.6 | 0 | 0 | 226 |
| A-1643R E.B. | BB-G | 1 1/2" Latex Concrete | 244 | 51.7 | 45.0 | 3.3 | 0 | 0 | 135 |
| A-1763R | BB-G | 1 1/2" Latex Concrete | 560 | 70.0 | 26.2 | 3.8 | 0 | 0 | 91 |
| A-3085 N.B. | STRG | 1 1/2" Latex Concrete | 164 | 90.9 | 9.1 | 0 | 0 | 0 | 23 |
| A-3085 S.B. | STRG | 1 1/2" Latex Concrete | 164 | 86.0 | 14.0 | 0 | 0 | 0 | 35 |
| A-3623 N.B. | STRG | 1 1/2" Latex Concrete | 232 | 78.9 | 21.1 | 0 | 0 | 0 | 53 |
| A-3623 S.B. | STRG | 1 1/2" Latex Concrete | 232 | 28.5 | 55.2 | 12.9 | 3.4 | 0 | 258 |
| A-3735 | STRG | 1 1/2" Latex Concrete | 217 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-3808 | STRG | 1 1/2" Latex Concrete | 248 | 99.6 | 0.1 | 0 | 0 | 0 | 0 |
| A-3809 | STRG | 1 1/2" Latex Concrete | 300 | 93.7 | 6.3 | 0 | 0 | 0 | 16 |
| A-3810 O.R. | STRG | 1 1/2" Latex Concrete | 204 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-3810 O.R. | STRG | 1 1/2" Latex Concrete | 200 | 42.5 | 51.5 | 6.0 | 0 | 0 | 169 |
| A-3823 | STRG | 1 1/2" Latex Concrete | 328 | 79.0 | 20.1 | 0.9 | 0 | 0 | 56 |
| J-493R | T-BM | 1 1/2" Latex Concrete | 175 | 58.6 | 28.4 | 10.9 | 2.1 | 0 | 165 |
| J-991R | PYTR | 1 1/2" Latex Concrete | 228 | 84.0 | 15.2 | 0.8 | 0 | 0 | 43 |
| L-641R | STRG | 1 1/2" Latex Concrete | 148 | 4.7 | 37.2 | 52.0 | 6.1 | 0 | 501 |

(+) A minor portion of this lane width was on a 2 1/2 inch overlay thickness.

# Table 6A
## 1989-1990 Survey
## LINEAL SURFACE CRACKING IN OVERLAYS

| Bridge No. & Direction | Type of Structure | Depth and Type of Overlay | No. of Grid Squares | No Cracking Clear Grids (%) | By (4 x 3)' Grid Squares (Weighted Average) (>0 to ≤5) Feet (%) | (>5 to <10) Feet (%) | (>10 to <15) Feet (%) | >15 Feet (%) | Cracking Per 1000 Sq.Ft. |
|---|---|---|---|---|---|---|---|---|---|
| L-887R W.B. | BB-G | None | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| L-887R E.B. | BB-G | None | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| A-93R E.B | BB-G | 1 1/2" Latex Concrete | 252 | 89.3 | 9.5 | 1.2 | 0.0 | 0.0 | 23 |
| A-93R W.B | BB-G | 1 1/2" Latex Concrete | 252 | 59.1 | 35.7 | 5.2 | 0.0 | 0.0 | 96 |
| A-1310R S.B. | STRG | 1 1/2" Latex Concrete | 208 | 64.9 | 34.6 | 0.5 | 0.0 | 0.0 | 63 |
| A-1310R N.B. | STRG | 1 1/2" Latex Concrete | 208 | 49.5 | 50.0 | 0.5 | 0.0 | 0.0 | 106 |
| A-1643R E.B. | BB-G | 1 1/2" Latex Concrete | 244 | 52.1 | 44.2 | 3.7 | 0.0 | 0.0 | 140 |
| A-1643R W.B. | BB-G | 1 1/2" Latex Concrete | 244 | 24.6 | 65.9 | 9.5 | 0.0 | 0.0 | 223 |
| A-1763R RAMP | BB-G | 1 1/2" Latex Concrete | 560 | 59.5 | 32.4 | 7.4 | 0.7 | 0.0 | 142 |
| A-3085 N.B. | STRG | 1 1/2" Latex Concrete | 164 | 92.1 | 6.7 | 1.2 | 0.0 | 0.0 | 18 |
| A-3085 S.B. | STRG | 1 1/2" Latex Concrete | 164 | 80.5 | 16.5 | 3.0 | 0.0 | 0.0 | 55 |
| A-3623 E.B. | STRG | 1 1/2" Latex Concrete | 232 | 23.3 | 55.2 | 18.1 | 3.4 | 0.0 | 281 |
| A-3623 W.B. | STRG | 1 1/2" Latex Concrete | 232 | 37.1 | 44.8 | 16.4 | 1.7 | 0.0 | 221 |
| A-3735 RAMP | STRG | 1 1/2" Latex Concrete | 217 | 88.5 | 11.5 | 0.0 | 0.0 | 0.0 | 20 |
| A-3808 RAMP | STRG | 1 1/2" Latex Concrete | 248 | 96.4 | 3.6 | 0.0 | 0.0 | 0.0 | 7 |
| A-3809 RAMP | STRG | 1 1/2" Latex Concrete | 300 | 84.8 | 9.3 | 5.6 | 0.3 | 0.0 | 55 |
| A-3810 O.R.EB | STRG | 1 1/2" Latex Concrete | 200 | 31.8 | 54.1 | 14.1 | 0.0 | 0.0 | 199 |
| A-3823 E.B. | STRG | 1 1/2" Latex Concrete | 328 | 62.0 | 36.0 | 2.0 | 0.0 | 0.0 | 76 |
| J-493R O.R.EB | T-BM | 1 1/2" Latex Concrete | 175 | 56.6 | 29.1 | 12.6 | 1.7 | 0.0 | 194 |
| J-991R W.B. | PYTR | 1 1/2" Latex Concrete | 228 | 82.5 | 13.6 | 3.9 | 0.0 | 0.0 | 45 |
| L-641R S.B. | STRG | 1 1/2" Latex Concrete | 151 | 2.0 | 40.4 | 51.0 | 6.6 | 0.0 | 504 |

Table 6 (Continued)
1982-1983 Survey
LINEAL SURFACE CRACKING IN OVERLAYS

| Bridge No. & Direction | Type of Structure | Depth and Type of Overlay | No. of Grid Squares | No Cracking, Clear Grids (%) | By (4 x 3)' Grid Squares (>0 to ≤5) Feet (%) | (>5 to ≤10) Feet (%) | (>10 to ≤15) Feet (%) | >15 Feet (%) | Cracking Per 1,000 Sq.Ft. |
|---|---|---|---|---|---|---|---|---|---|
| L-669R | T-BM | 1 1/2" Latex Concrete | 84 | 100 | 0 | 0 | 0 | 0 | 0 |
| L-759R | SLAB | 1 1/2" Latex Concrete | 132 | 36.4 | 48.5 | 15.1 | 0 | 0 | 222 |
| A-3005 | STRG | 1 3/4-2" Latex Concrete | 336 | 93.4 | 6.6 | 0 | 0 | 0 | 17 |
| L-717R W.B. | STRG | 1 3/4" Latex Concrete | 120 | 95.0 | 5.0 | 0 | 0 | 0 | 13 |
| L-717R E.B. | STRG | 1 3/4" Latex Concrete | 120 | 92.5 | 7.5 | 0 | 0 | 0 | 19 |
| A-211R | SLAB | 2" Latex Concrete | 168 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-3824 | STRG | 2" Latex Concrete | 296 | 86.5 | 13.5 | 0 | 0 | 0 | 34 |
| A-3004 | STRG | 2 1/4" Latex Concrete | 216 | 91.2 | 8.8 | 0 | 0 | 0 | 22 |
| A-2672 N.B. | STRG | 1" Latex Mortar | 230 | 94.3 | 5.7 | 0 | 0 | 0 | 14 |
| A-2672 S.B. | STRG | 1" Latex Mortar | 230 | 99.1 | 0.9 | 0 | 0 | 0 | 2 |
| A-2682 N.B. | STRG | 1" Latex Mortar | 100 | 86.0 | 14.0 | 0 | 0 | 0 | 35 |
| A-2682 S.B. | STRG | 1" Latex Mortar | 100 | 93.0 | 7.0 | 0 | 0 | 0 | 18 |
| A-2683 N.B. | STRG | 1" Latex Mortar | 152 | 92.1 | 7.2 | 0.7 | 0 | 0 | 23 |
| A-2683 S.B. | STRG | 1" Latex Mortar | 152 | 86.8 | 13.2 | 0 | 0 | 0 | 33 |
| A-2684 N.B. | STRG | 1" Latex Mortar | 100 | 78.0 | 17.0 | 5.0 | 0 | 0 | 76 |
| A-2684 S.B. | STRG | 1" Latex Mortar | 100 | 89.0 | 10.0 | 1.0 | 0 | 0 | 32 |
| A-2738 | STRG | 1" Latex Mortar | 252 | 82.1 | 17.9 | 0 | 0 | 0 | 45 |
| L-501R | STRG | 1 3/4" Low Slump | 204 | 3.9 | 46.1 | 46.6 | 3.4 | 0 | 460 |
| L-642R | STRG | 1 3/4" Low Slump | 147 | 14.3 | 58.5 | 24.5 | 2.7 | 0 | 336 |
| A-119R | SLAB | 2" Low Slump | 188 | 39.2 | 50.9 | 9.9 | 0 | 0 | 193 |
| A-2232 | STRG | 2" Low Slump | 1,084 | 97.5 | 1.9 | 0.6 | 0 | 0 | 9 |
| A-2233 | SLAB | 2" Low Slump | 164 | 93.9 | 4.9 | 1.2 | 0 | 0 | 20 |

16

17

all removed by 2003

**Table 6A**
**1989-1990 Survey**
**LINEAL SURFACE CRACKING IN OVERLAYS**

| Bridge No. & Direction | Type of Structure | Depth and Type of Overlay | No. of Grid Squares | No Cracking Clear Grids (%) | By (4 x 3)' Grid Squares (Weighted Average) (>0 to ≤5) Feet (%) | (>5 to <10) Feet (%) | (>10 to <15) Feet (%) | >15 Feet (%) | Cracking Per 1000 Sq.Ft. | |
|---|---|---|---|---|---|---|---|---|---|---|
| L-669R | T-BM | 1 1/2" Latex Concrete | 84 | 77.4 | 21.4 | 1.2 | 0.0 | 0.0 | 40 | |
| L-759 S.B. | SLAB | 1 1/2" Latex Concrete | 132 | 9.5 | 24.1 | 31.4 | 32.1 | 2.9 | 679 | |
| A-3005 E.B. | STRG | 1 3/4"-2" Latex Concrete | 336 | 74.1 | 25.3 | 0.6 | 0.0 | 0.0 | 59 | |
| L-0717R W.B. | STRG | 1 3/4" Latex Concrete | 120 | 88.3 | 10.0 | 1.7 | 0.0 | 0.0 | 77 | 76 |
| L-0717R E.B. | STRG | 1 3/4" Latex Concrete | 120 | 67.5 | 27.5 | 5.0 | 0.0 | 0.0 | 93 | |
| A-0211R E.B. | SLAB | 2" Latex Concrete | 168 | 84.6 | 12.4 | 3.0 | 0.0 | 0.0 | 42 | 62 |
| A-3824 E.B. | STRG | 2" Latex Concrete | 296 | 69.9 | 26.4 | 3.7 | 0.0 | 0.0 | 82 | |
| A-3004 E.B. | STRG | 2 1/4" Latex Concrete | 216 | 76.9 | 23.1 | 0.0 | 0.0 | 0.0 | 47 | |
| A-2672 N.B. | STRG | 1" Latex Mortar | 230 | 77.8 | 20.9 | 1.3 | 0.0 | 0.0 | 48 | |
| A-2672 S.B. | STRG | 1" Latex Mortar | 230 | 78.3 | 20.0 | 1.7 | 0.0 | 0.0 | 45 | |
| A-2682 N.B. | STRG | 1" Latex Mortar | 100 | 24.0 | 48.0 | 18.0 | 8.0 | 2.0 | 311 | |
| A-2682 S.B. | STRG | 1" Latex Mortar | 100 | 63.0 | 32.0 | 3.0 | 2.0 | 0.0 | 90 | |
| A-2683 N.B. | STRG | 1" Latex Mortar | 152 | 92.8 | 6.6 | 0.6 | 0.0 | 0.0 | 18 | |
| A-2683 S.B. | STRG | 1" Latex Mortar | 152 | 50.7 | 41.4 | 7.9 | 0.0 | 0.0 | 91 | |
| A-2684 N.B. | STRG | 1" Latex Mortar | 100 | 51.0 | 37.0 | 10.0 | 2.0 | 0.0 | 167 | |
| A-2684 S.B. | STRG | 1" Latex Mortar | 100 | 23.0 | 43.0 | 32.0 | 2.0 | 0.0 | 322 | |
| A-2738 S.B. | STRG | 1" Latex Mortar | 252 | 70.2 | 13.5 | 16.3 | 0.0 | 0.0 | 127 | |
| L-501R S.B. | STRG | 1 3/4" Low Slump | 204 | 9.5 | 62.4 | 27.1 | 1.0 | 0.0 | 332 | |
| L-642R N.B. | STRG | 1 3/4" Low Slump | 149 | 12.1 | 77.2 | 9.4 | 1.3 | 0.0 | 272 | |
| A-119R E.B. | SLAB | 2" Low Slump | 188 | 27.1 | 51.6 | 19.2 | 2.1 | 0.0 | 263 | |
| A-2232 RAMP | STRG | 2" Low Slump | 1084 | 28.8 | 50.7 | 18.8 | 1.7 | 0.0 | 248 | |
| A-2233 RAMP | SLAB | 2" Low Slump | 164 | 24.4 | 31.8 | 22.0 | 14.0 | 7.9 | 426 | |

Table 6 (Continued)
1982-1983 Survey
LINEAL SURFACE CRACKING IN OVERLAYS

| Bridge No. & Direction | Type of Structure | Depth and Type of Overlay | By (4 x 3)' Grid Squares | | | | | | Cracking Per 1,000 Sq.Ft. |
|---|---|---|---|---|---|---|---|---|---|
| | | | No. of Grid Squares | No Cracking, Clear Grids (%) | (>0 to ≤5) Feet (%) | (>5 to ≤10) Feet (%) | (>10 to ≤15) Feet (%) | >15 Feet (%) | |
| A-2234 | SLAB | 2" Low Slump | 180 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-2235 | SLAB | 2" Low Slump | 136 | 92.6 | 7.4 | 0 | 0 | 0 | 19 |
| A-3047 N.B. | STRG | 2" Low Slump | 1,000 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-3047 S.B. | STRG | 2" Low Slump | 1,000 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-3292 | THTR | 2" Low Slump | 2,004 | 9.6 | 41.1 | 38.0 | 10.1 | 1.2 | 475 |
| A-3520 | STRG | 2" Low Slump | 264 | 58.7 | 29.9 | 9.5 | 1.9 | 0 | 157 |
| A-3521 | STRG | 2" Low Slump | 276 | 47.8 | 50.4 | 1.8 | 0 | 0 | 138 |
| A-3522 | STRG | 2" Low Slump | 164 | 65.2 | 31.1 | 3.7 | 0 | 0 | 103 |
| A-3671 | STRG | 2" Low Slump | 152 | 90.1 | 9.9 | 0 | 0 | 0 | 25 |
| A-3706 W.B. | SLAB | 2" Low Slump | 88 | 98.9 | 1.1 | 0 | 0 | 0 | 3 |
| A-3706 E.B. | SLAB | 2" Low Slump | 88 | 98.9 | 1.1 | 0 | 0 | 0 | 3 |
| A-3792 W.B. | SLAB | 2" Low Slump | 204 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-3792 E.B. | SLAB | 2" Low Slump | 202 | 99.0 | 1.0 | 0 | 0 | 0 | 3 |
| A-3830 | SLAB | 2" Low Slump | 160 | 93.8 | 6.2 | 0 | 0 | 0 | 16 |
| A-3831 | SLAB | 2" Low Slump | 160 | 100 | 0 | 0 | 0 | 0 | 0 |
| L-293R | STRG | 2" Low Slump | 292 | 100 | 0 | 0 | 0 | 0 | 0 |
| L-319R W.B. | STRG | 2" Low Slump | 508 | 98.8 | 1.2 | 0 | 0 | 0 | 3 |
| L-319R E.B. | STRG | 2" Low Slump | 127 | 87.4 | 12.6 | 0 | 0 | 0 | 32 |
| A-2116 W.B. | STRG | 2 1/4" Low Slump | 204 | 82.4 | 17.6 | 0 | 0 | 0 | 44 |
| A-2116 E.B. | STRG | 2 1/4" Low Slump | 204 | 87.7 | 12.3 | 0 | 0 | 0 | 31 |
| A-2117 N.B. | STRG | 2 1/4" Low Slump | 256 | 75.3 | 23.3 | 1.4 | 0 | 0 | 67 |
| A-2117 S.B. | STRG | 2 1/4" Low Slump | 256 | 28.3 | 63.2 | 8.5 | 0 | 0 | 215 |

## Table 6A
## 1989-1990 Survey
## LINEAL SURFACE CRACKING IN OVERLAYS

| Bridge No. & Direction | Type of Structure | Depth and Type of Overlay | No. of Grid Squares | No Cracking Clear Grids (%) | By (4 x 3)' Grid Squares (Weighted Average) (>0 to ≤5) Feet (%) | (>5 to <10) Feet (%) | (>10 to <15) Feet (%) | >15 Feet (%) | Cracking Per 1000 Sq.Ft. |
|---|---|---|---|---|---|---|---|---|---|
| A-2234 RAMP | SLAB | 2" Low Slump | 180 | 57.2 | 26.1 | 16.1 | 0.6 | 0.0 | 198 |
| A-2235 RAMP | SLAB | 2" Low Slump | 136 | 59.5 | 36.0 | 4.5 | 0.0 | 0.0 | 107 |
| A-3047 N.B. | STRG | 2" Low Slump | 1000 | 3.6 | 16.1 | 33.9 | 33.9 | 12.5 | 797 |
| A-3047 S.B. | STRG | 2" Low Slump | 1000 | 8.3 | 16.7 | 43.3 | 25.0 | 6.7 | 707 |
| A-3292 E.B. | THTR | 2" Low Slump | 876 | 4.3 | 28.0 | 49.1 | 16.3 | 2.3 | 540 |
| A-3520 E.B. | STRG | 2" Low Slump | 264 | 40.5 | 54.2 | 5.3 | 0.0 | 0.0 | 144 |
| A-3521R S.B.(1) | STRG | 2 1/4" Low Slump | 276 | 34.4 | 50.0 | 14.5 | 1.1 | 0.0 | 204 |
| A-3522 E.B. | STRG | 2" Low Slump | 164 | 49.4 | 42.1 | 8.5 | 0.0 | 0.0 | 140 |
| A-3671 E.B. | STRG | 2" Low Slump | 152 | 61.9 | 32.2 | 5.9 | 0.0 | 0.0 | 101 |
| A-3706 W.B. | SLAB | 2" Low Slump | 88 | 43.2 | 33.0 | 20.4 | 3.4 | 0.0 | 233 |
| A-3706 E.B. | SLAB | 2" Low Slump | 88 | 34.1 | 47.8 | 15.9 | 1.1 | 1.1 | 148 |
| A-3792 W.B. | SLAB | 2" Low Slump | 204 | 43.1 | 35.3 | 17.6 | 3.5 | 0.5 | 235 |
| A-3792 E.B. | SLAB | 2" Low Slump | 204 | 13.7 | 37.3 | 34.3 | 11.8 | 2.9 | 500 |
| A-3830 E.B. | SLAB | 2" Low Slump | 160 | 59.4 | 34.4 | 6.2 | 0.0 | 0.0 | 113 |
| A-3831 RAMP | SLAB | 2" Low Slump | 64 | 81.2 | 18.8 | 0.0 | 0.0 | 0.0 | 39 |
| L-293R S.B. | STRG | 2" Low Slump | 250 | 11.6 | 64.8 | 23.2 | 0.4 | 0.0 | 243 |
| L-319R W.B. | STRG | 2" Low Slump | 508 | 58.3 | 34.1 | 6.6 | 1.0 | 0.0 | 119 |
| L-319R E.B. | STRG | 2" Low Slump | 508 | 65.8 | 30.1 | 3.7 | 0.4 | 0.0 | 81 |
| A-2116 W.B. | STRG | 2 1/4" Low Slump | 204 | 58.0 | 41.9 | 0.1 | 0.0 | 0.0 | 97 |
| A-2116 E.B. | STRG | 2 1/4" Low Slump | 204 | 93.6 | 6.4 | 0.0 | 0.0 | 0.0 | 15 |
| A-2117 N.B. | STRG | 2 1/4" Low Slump | 256 | 46.8 | 46.5 | 6.3 | 0.4 | 0.0 | 148 |
| A-2117 S.B. | STRG | 2 1/4" Low Slump | 256 | 22.7 | 58.9 | 17.2 | 1.2 | 0.0 | 253 |

(1) In 1984 Bridge A-3521R had the 2" overlay removed and a new 2 1/2" Low Slump overlay placed.

Table 6 (Continued)
1982-1983 Survey
LINEAL SURFACE CRACKING IN OVERLAYS

| Bridge No. & Direction | Type of Structure | Depth and Type of Overlay | No. of Grid Squares | By (4 x 3)' Grid Squares | | | | | Cracking Per 1,000 Sq.Ft. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | No Cracking, Clear Grids (%) | (>0 to ≤5) Feet (%) | (>5 to ≤10) Feet (%) | (>10 to ≤15) Feet (%) | >15 Feet (%) | |
| A-2118 W.B. | STRG | 2 1/4" Low Slump | 332 | 71.4 | 27.7 | 0.9 | 0 | 0 | 75 |
| A-2118 E.B. | STRG | 2 1/4" Low Slump | 332 | 75.9 | 23.2 | 0.9 | 0 | 0 | 64 |
| A-2119 W.B. | STRG | 2 1/4" Low Slump | 252 | 73.8 | 26.2 | 0 | 0 | 0 | 66 |
| A-2119 E.B. | STRG | 2 1/4" Low Slump | 252 | 92.9 | 7.1 | 0 | 0 | 0 | 18 |
| A-2132 W.B. | SLAB | 2 1/4" Low Slump | 128 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-2132 E.B. | SLAB | 2 1/4" Low Slump | 128 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-2224 | STRG | 2 1/4" Low Slump | 240 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-2225 N.B. | STRG | 2 1/4" Low Slump | 1,044 | 95.5 | 4.5 | 0 | 0 | 0 | 11 |
| A-2225 S.B. | STRG | 2 1/4" Low Slump | 1,044 | 98.7 | 1.3 | 0 | 0 | 0 | 3 |
| A-2226 | GIRD | 2 1/4" Low Slump | 336 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-2227 | GIRD | 2 1/4" Low Slump | 336 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-2228 | GIRD | 2 1/4" Low Slump | 560 | 96.2 | 3.8 | 0 | 0 | 0 | 10 |
| A-2229 | GIRD | 2 1/4" Low Slump | 508 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-2230 | GIRD | 2 1/4" Low Slump | 420 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-2231 | GIRD | 2 1/4" Low Slump | 520 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-2513 | STRG | 2 1/4" Low Slump | 308 | 93.5 | 6.5 | 0 | 0 | 0 | 16 |
| A-2514 | STRG | 2 1/4" Low Slump | 300 | 87.0 | 13.0 | 0 | 0 | 0 | 33 |
| A-2847 | STRG | 2 1/4" Low Slump | 220 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-2908 N.B. | STRG | 2 1/4" Low Slump | 244 | 95.1 | 4.9 | 0 | 0 | 0 | 12 |
| A-2908 S.B. | STRG | 2 1/4" Low Slump | 244 | 77.9 | 20.9 | 1.2 | 0 | 0 | 60 |
| A-2984 | STRG | 2 1/4" Low Slump | 164 | 97.0 | 3.0 | 0 | 0 | 0 | 8 |
| A-2985 | STRG | 2 1/4" Low Slump | 164 | 98.2 | 1.8 | 0 | 0 | 0 | 5 |

## Table 6A
## 1989-1990 Survey
## LINEAL SURFACE CRACKING IN OVERLAYS

| Bridge No. & Direction | Type of Structure | Depth and Type of Overlay | No. of Grid Squares | No Cracking Clear Grids (%) | By (4 x 3)' Grid Squares (Weighted Average) (>0 to ≤5) Feet (%) | (>5 to <10) Feet (%) | (>10 to <15) Feet (%) | >15 Feet (%) | Cracking Per 1000 Sq.Ft. |
|---|---|---|---|---|---|---|---|---|---|
| A-2118 W.B. | STRG | 2 1/4" Low Slump | 332 | 34.7 | 53.3 | 11.4 | 0.6 | 0.0 | 195 |
| A-2118 E.B. | STRG | 2 1/4" Low Slump | 332 | 63.3 | 33.1 | 3.3 | 0.3 | 0.0 | 88 |
| A-2119 W.B. | STRG | 2 1/4" Low Slump | 252 | 61.1 | 33.3 | 5.6 | 0.0 | 0.0 | 104 |
| A-2119 E.B. | STRG | 2 1/4" Low Slump | 252 | 77.7 | 22.3 | 0.0 | 0.0 | 0.0 | 38 |
| A-2132 N.B. | SLAB | 2 1/4" Low Slump | 128 | 12.5 | 23.4 | 26.6 | 6.3 | 31.2 | 340 |
| A-2132 S.B. | SLAB | 2 1/4" Low Slump | 128 | 27.2 | 25.8 | 18.8 | 14.1 | 14.1 | 516 |
| A-2224 S.B. | STRG | 2 1/4" Low Slump | 240 | 75.4 | 23.3 | 1.3 | 0.0 | 0.0 | 53 |
| A-2225 N.B. | STRG | 2 1/4" Low Slump | 1044 | 58.2 | 34.3 | 4.4 | 0.3 | 2.8 | 145 |
| A-2225 S.B. | STRG | 2 1/4" Low Slump | 1042 | 38.0 | 27.6 | 11.7 | 3.0 | 19.7 | 561 |
| A-2226 RAMP | GIRD | 2 1/4" Low Slump | 336 | 85.0 | 15.0 | 0.0 | 0.0 | 0.0 | 16 |
| A-2227 RAMP | GIRD | 2 1/4" Low Slump | 336 | 74.7 | 23.8 | 1.5 | 0.0 | 0.0 | 33 |
| A-2228 RAMP | GIRD | 2 1/4" Low Slump | 420 | 5.5 | 44.8 | 49.7 | 0.0 | 0.0 | 399 |
| A-2229 RAMP | GIRD | 2 1/4" Low Slump | 508 | 0.0 | 61.0 | 38.0 | 1.0 | 0.0 | 72 |
| A-2230 RAMP | GIRD | 2 1/4" Low Slump | 420 | 63.5 | 34.7 | 1.8 | 0.0 | 0.0 | 53 |
| A-2231 RAMP | GIRD | 2 1/4" Low Slump | 520 | 76.0 | 23.0 | 1.0 | 0.0 | 0.0 | 43 |
| A-2513 W.B. | STRG | 2 1/4" Low Slump | 308 | 56.2 | 39.3 | 4.5 | 0.0 | 0.0 | 114 |
| A-2514 E.B. | STRG | 2 1/4" Low Slump | 300 | 41.7 | 26.3 | 32.0 | 0.0 | 0.0 | 271 |
| A-2847 N.B. | STRG | 2 1/4" Low Slump | 220 | 65.0 | 31.0 | 4.0 | 0.0 | 0.0 | 69 |
| A-2908 N.B. | STRG | 2 1/4" Low Slump | 244 | 50.0 | 38.9 | 10.7 | 0.4 | 0.0 | 149 |
| A-2908 S.B. | STRG | 2 1/4" Low Slump | 244 | 45.9 | 46.7 | 7.4 | 0.0 | 0.0 | 139 |
| A-2984 S.B. | STRG | 2 1/4" Low Slump | 164 | 71.9 | 22.0 | 6.1 | 0.0 | 0.0 | 85 |
| A-2985 N.B. | STRG | 2 1/4" Low Slump | 164 | 64.0 | 25.6 | 9.8 | 0.6 | 0.0 | 99 |

Table 6 (Continued)
1982-1983 Survey
LINEAL SURFACE CRACKING IN OVERLAYS

| Bridge No. & Direction | Type of Structure | Depth and Type of Overlay | No. of Grid Squares | By (4 x 3)' Grid Squares: No Cracking, Clear Grids (%) | (>0 to ≤5) Feet (%) | (>5 to ≤10) Feet (%) | (>10 to ≤15) Feet (%) | >15 Feet (%) | Cracking Per 1,000 Sq.Ft. |
|---|---|---|---|---|---|---|---|---|---|
| A-2986 | SLAB | 2 1/4" Low Slump | 148 | 41.5 | 34.4 | 18.2 | 5.0 | 0.9 | 271 |
| A-2987 | SLAB | 2 1/4" Low Slump | 132 | 25.5 | 57.3 | 17.2 | 0 | 0 | 258 |
| A-3128 | STRG | 2 1/4" Low Slump | 188 | 37.8 | 54.2 | 8.0 | 0 | 0 | 189 |
| A-3162 | STRG | 2 1/4" Low Slump | 2,110 | 60.3 | 36.1 | 3.6 | 0 | 0 | 114 |
| A-3351 | STRG | 2 1/4" Low Slump | 300 | 80.7 | 19.3 | 0 | 0 | 0 | 48 |
| A-3352 | SLAB | 2 1/4" Low Slump | 168 | 78.0 | 18.4 | 3.6 | 0 | 0 | 70 |
| A-3353 | GIRD | 2 1/4" Low Slump | 324 | 80.6 | 19.4 | 0 | 0 | 0 | 49 |
| A-3483 | STRG | 2 1/4" Low Slump | 192 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-3494 | STRG | 2 1/4" Low Slump | 272 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-3496 | STRG | 2 1/4" Low Slump | 208 | 97.1 | 2.9 | 0 | 0 | 0 | 7 |
| A-3498 | STRG | 2 1/4" Low Slump | 176 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-3500 | STRG | 2 1/4" Low Slump | 212 | 100 | 0 | 0 | 0 | 0 | 0 |
| A-3547 N.B. | STRG | 2 1/4" Low Slump | 248 | 66.1 | 32.2 | 1.6 | 0 | 0 | 92 |
| A-3547 S.B. | STRG | 2 1/4" Low Slump | 248 | 62.9 | 36.3 | 0.8 | 0 | 0 | 96 |
| A-3617 N.B. | STRG | 2 1/4" Low Slump | 288 | 99.3 | 0.7 | 0 | 0 | 0 | 2 |
| A-3617 S.B. | STRG | 2 1/4" Low Slump | 288 | 79.2 | 20.8 | 0 | 0 | 0 | 52 |
| | | TOTALS: | 31,778 | | | | | | |

**Code for Type of Structure further defined:**

**Box Beam or Girder (BB-G), Girder (GIRD), Pony Truss (PYTR), Slab (SLAB), Stringer/Multi-Beam or Girder (STRG), Tee Beam (T-BM), and Thru Truss (THTR).**

O.R. = Outer Roadway
R=Rehabilitated Bridge Deck

# Table 6A
## 1989-1990 Survey
## LINEAL SURFACE CRACKING IN OVERLAYS

| Bridge No. & Direction | Type of Structure | Depth and Type of Overlay | No. of Grid Squares | No Cracking Clear Grids (%) | By (4 x 3)' Grid Squares (Weighted Average) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | (>0 to ≤5) Feet (%) | (>5 to <10) Feet (%) | (>10 to <15) Feet (%) | >15 Feet (%) | Cracking Per 1000 Sq.Ft. |
| A-2986 S.B. | SLAB | 2 1/4" Low Slump | 148 | 18.2 | 31.9 | 27.7 | 14.1 | 8.1 | 515 |
| A-2987 N.B. | SLAB | 2 1/4" Low Slump | 132 | 6.1 | 40.2 | 43.1 | 9.8 | 0.8 | 441 |
| A-3128 | STRG | 2 1/4" Low Slump | 188 | 28.7 | 60.1 | 9.6 | 1.6 | 0.0 | 217 |
| A-3162 W.B. | STRG | 2 1/4" Low Slump | 1971 | 49.3 | 44.6 | 5.5 | 0.6 | 0.0 | 136 |
| A-3351 RAMP | STRG | 2 1/4" Low Slump | 300 | 72.3 | 27.7 | 0.0 | 0.0 | 0.0 | 52 |
| A-3352 RAMP | SLAB | 2 1/4" Low Slump | 168 | 77.4 | 10.7 | 11.9 | 0.0 | 0.0 | 93 |
| A-3353 RAMP | GIRD | 2 1/4" Low Slump | 324 | 81.8 | 18.2 | 0.0 | 0.0 | 0.0 | 39 |
| A-3483 E.B. | STRG | 2 1/4" Low Slump | 192 | 71.4 | 27.6 | 1.0 | 0.0 | 0.0 | 62 |
| A-3494 E.B. | STRG | 2 1/4" Low Slump | 272 | 42.3 | 39.7 | 16.9 | 1.1 | 0.0 | 170 |
| A-3496 N.B. | STRG | 2 1/4" Low Slump | 208 | 54.8 | 42.3 | 2.9 | 0.0 | 0.0 | 87 |
| A-3498 N.B. | STRG | 2 1/4" Low Slump | 176 | 35.8 | 52.2 | 11.4 | 0.6 | 0.0 | 197 |
| A-3500 N.B. | STRG | 2 1/4" Low Slump | 212 | 58.5 | 40.6 | 0.9 | 0.0 | 0.0 | 72 |
| A-3547 N.B. | STRG | 2 1/4" Low Slump | 248 | 65.3 | 31.5 | 3.2 | 0.0 | 0.0 | 88 |
| A-3547 S.B. | STRG | 2 1/4" Low Slump | 248 | 52.0 | 46.8 | 0.8 | 0.4 | 0.0 | 114 |
| A-3617 N.B. | STRG | 2 1/4" Low Slump | 288 | 98.3 | 1.7 | 0.0 | 0.0 | 0.0 | 3 |
| A-3617 S.B. | STRG | 2 1/4" Low Slump | 288 | 80.6 | 19.4 | 0.0 | 0.0 | 0.0 | 32 |
| A-3664 E.B.(2) | STRG | 2 1/4" Low Slump | 1,658 | 33.5 | 49.4 | 14.4 | 2.5 | 0.2 | 173 |
| | | TOTALS: | 31,281 | | | | | | |

Code for type of Structure further defined:

Box Beam or Girder (BB-G), Girder (Gird), Pony Truss (pytr), Slab (SLAB), Stringer/Multi-Beam or Girder (STRG), Tee Beam (T-BM), and Thru Truss (THTR).

O.R. = Outer Roadway

R=Rehabilitated Bridge Deck

(2) = Bridge surveyed in 1989-90 only, not surveyed in 1982-83.

Table 7

1982-1983 Survey
DEBONDING AND/OR DELAMINATION AND PATCHING
BY INDIVIDUAL DECKS (1)

| Bridge No. & Direction | Depth and Type of Overlay | Surveyed Area Sq.Ft. | Debonded and/or Delam. Area Sq.Ft. | Debonded and/or Delam. Area % | Patching Area Sq.Ft. | Patching Area % |
|---|---|---|---|---|---|---|
| L-887R W.B. | 1" Min. LC | 4,752 | 72 | 1.5 | 0 | 0 |
| L-887R E.B. | 1" Min. LC | 4,752 | 122 | 2.5 | 0 | 0 |
| A-93R W.B. | 1 1/2" LC | 3,072 | 17 | 0.6 | 0 | 0 |
| A-93R E.B. | 1 1/2" LC | 3,072 | 0 | 0 | 11 | 0.4 |
| A-1643R W.B. | 1 1/2" LC | 2,928 | 4 | 0.2 | 0 | 0 |
| A-1763R | 1 1/2" LC | 6,720 | 228 | 3.4 | 0 | 0 |
| A-3623 S.B. | 1 1/2" LC | 2,784 | 30 | 1.1 | 0 | 0 |
| A-3809 | 1 1/2" LC | 3,600 | 2 | 0.1 | 0 | 0 |
| J-493R | 1 1/2" LC | 2,100 | 2 | 0.1 | 0 | 0 |
| L-641R | 1 1/2" LC | 1,776 | 86 | 4.8 | 0 | 0 |
| L-759R S.B. | 1 1/2" LC | 1,584 | 108 | 6.8 | 0 | 0 |
| L-717R E.B. | 1 3/4" LC | 1,440 | 7 | 0.5 | 0 | 0 |
| A-211R | 2" LC | 2,016 | 3 | 0.1 | 0 | 0 |
| A-2682 N.B. | 1" LM | 1,200 | 1 | 0.1 | 0 | 0 |
| A-2682 S.B. | 1" LM | 1,200 | 0 | 0 | 14 | 1.2 |
| A-2684 N.B. | 1" LM | 1,200 | 3 | 0.2 | 0 | 0 |
| L-501R S.B. | 1 3/4" LSC | 2,448 | 36 | 1.5 | 0 | 0 |
| L-642R N.B. | 1 3/4" LSC | 1,764 | 123 | 6.9 | 0 | 0 |
| A-3520 | 2" LSC | 3,168 | 97 | 3.1 | 409* | 12.9 |
| A-3521 | 2" LSC | 3,312 | 1,155 | 34.9 | 0 | 0 |
| L-293R | 2" LSC | 3,504 | 0 | 0 | 6 | 0.2 |
| A-2226 | 2 1/4" LSC | 4,032 | 0 | 0 | 4 | 0.1 |
| A-3162 | 2 1/4" LSC | 25,320 | 40 | 0.3 | 16 | 0.1 |
| A-3352 | 2 1/4" LSC | 2,016 | 5 | 0.2 | 10 | 0.5 |

R = Rehabilitated Bridge Deck

(1) Eighty additional deck driving lanes had either none or < 0.1% of surveyed area effected.

*Debonded area patched and occurred prior to opening to traffic.

Table 7A
1989-1990 Survey
DEBONDING AND/OR DELAMINATION AND PATCHING
BY INDIVIDUAL DECKS (1)

| Bridge No. & Direction | Depth and Type of Overlay | Surveyed Area Sq. Ft. | Debonded and/or Delam. Area Sq.Ft. | % | Patching Area Sq.Ft. | % |
|---|---|---|---|---|---|---|
| L-887R W.B.(2) | 1 1/2" LC w/CP | 0 | 0 | 0 | 0 | 0 |
| L-887R E.B.(2) | 1 1/2" LC w/CP | 0 | 0 | 0 | 0 | 0 |
| A-93R E.B. | 1 1/2" LC | 3,060 | 28 | 0.9 | 9 | 0.3 |
| A-93R W.B.B | 1 1/2" LC | 3,060 | 109 | 3.6 | 0 | 0.0 |
| A-1763R RAMP | 1 1/2" LC | 6,720 | 1,505 | 22.4 | 0 | 0.0 |
| A-3623 W.B. | 1 1/2" LC | 2,772 | 6 | 0.2 | 0 | 0.0 |
| A-3809 RAMP | 1 1/2" LC | 3,888 | 6 | 0.1 | 0 | 0.0 |
| J-493R O.R. EB | 1 1/2" LC | 1,518 | 3 | 0.2 | 0 | 0.0 |
| L-641R S.B. | 1 1/2" LC | 1,788 | 243 | 13.6 | 0 | 0.0 |
| L-759R S.B. | 1 1/2" LC | 1,596 | 335 | 21.0 | 128 | 8.0 |
| L-717R E.B. | 1 3/4" LC | 1,440 | 7 | 0.5 | 0 | 0.0 |
| A-211R E.B. | 2" LC | 2,016 | 9 | 0.4 | 0 | 0.0 |
| A-2682 N.B. | 1" LM | 1,200 | 1 | 0.1 | 0 | 0.0 |
| A-2682 S.B. | 1" LM | 1,200 | 20 | 1.7 | 12 | 1.0 |
| A-2684 N.B. | 1" LM | 1,200 | 8 | 0.6 | 0 | 0.0 |
| L-501R S.B. | 1 3/4" LSC | 2,484 | 97 | 3.9 | 27 | 1.1 |
| L-642R N.B. | 1 3/4" LSC | 1,788 | 164 | 9.1 | 0 | 0.0 |
| A-3520 E.B. | 2" LSC | 3,120 | 163 | 5.2 | 426 | 13.7 |
| A-3521 S.B.(EB)(3) | 2 1/4" LSC | 3,276 | 0 | 0 | 0 | 0 |
| A-2226 RAMP | 2 1/4" LSC | 6,660 | 40 | 0.6 | 4 | 0.1 |
| A-3162 W.B. | 2 1/4" LSC | 23,652 | 62 | 0.3 | 202 | 0.9 |

R = Rehabilitated Bridge Deck

(1) 42 additional deck driving lanes were found with delamination or patching during the 1989-90 survey and are listed on the next page,the 42 remaining deck driving lanes had either none or <0.1% of the surveyed area effected.
(2) Bridges L-887R EB and L-887R WB were redecked with Cathodic Protection in 1985 and therefore not surveyed in 1989-90.
(3) In 1984 Bridge A-3521R had the 2" overlay removed and a new 2 1/2" Low Slurr overlay placed.

Table 7A (Continued)
1989-1990 Survey
DEBONDING AND/OR DELAMINATION AND PATCHING
BY INDIVIDUAL DECKS (1)

| Bridge No. & Direction | Depth and Type of Overlay | Surveyed Area Sq. Ft. | Debonded and/or Delam. Area Sq.Ft. | % | Patching Area Sq.Ft. | % |
|---|---|---|---|---|---|---|
| A-3085 S.B. | 1 1/2" LC | 1,992 | 2 | 0.1 | 0 | 0.0 |
| A-3623 E.B. | 1 1/2" LC | 2,772 | 4 | 0.2 | 0 | 0.0 |
| A-3735 RAMP | 1 1/2" LC | 2,604 | 3 | 0.1 | 0 | 0.0 |
| A-3810 O.R. EB | 1 1/2" LC | 2,400 | 29 | 1.2 | 0 | 0.0 |
| A-3823 E.B. | 1 1/2" LC | 3,936 | 4 | 0.1 | 0 | 0.0 |
| J-991R W.B. | 1 1/2" LC | 2,748 | 7 | 0.3 | 0 | 0.0 |
| A-3005 E.B. | 1 3/4"-2" LC | 3,948 | 24 | 0.6 | 0 | 0.0 |
| A-3824 E.B. | 2" LC | 3,552 | 18 | 0.5 | 0 | 0.0 |
| A-3004 E.B. | 2 1/4" LC | 2,592 | 2 | 0.1 | 0 | 0.0 |
| A-2672 N.B. | 1" LM | 2,736 | 72 | 2.6 | 0 | 0.0 |
| A-2672 S.B. | 1" LM | 2,736 | 27 | 1.0 | 0 | 0.0 |
| A-2684 S.B. | 1" LM | 1,200 | 1 | 0.1 | 0 | 0.0 |
| A-2738 S.B. | 1" LM | 3,000 | 14 | 0.5 | 0 | 0.0 |
| A-119R E.B. | 2" LSC | 2,256 | 6 | 0.3 | 0 | 0.0 |
| A-2232 RAMP | 2" LSC | 9,756 | 127 | 1.3 | 0 | 0.0 |
| A-3292 E.B. | 2" LSC | 10,536 | 19 | 0.2 | 0 | 0.0 |
| A-3706 W.B. | 2" LSC | 1,056 | 1 | 0.1 | 0 | 0.0 |
| L-293R S.B. | 2" LSC | 3,600 | 0 | 0.0 | 6 | 0.2 |
| L-319R E.B. | 2" LSC | 6,144 | 12 | 0.2 | 0 | 0.0 |
| L-319R W.B. | 2" LSC | 6,144 | 10 | 0.2 | 0 | 0.0 |
| A-2117 N.B. | 2 1/4" LSC | 3,096 | 12 | 0.4 | 0 | 0.0 |
| A-2117 S.B. | 2 1/4" LSC | 3,096 | 3 | 0.1 | 0 | 0.0 |
| A-2118 W.B. | 2 1/4" LSC | 3,984 | 8 | 0.2 | 0 | 0.0 |
| A-2119 E.B. | 2 1/4" LSC | 3,000 | 6 | 0.2 | 0 | 0.0 |
| A-2119 W.B. | 2 1/4" LSC | 3,000 | 12 | 0.4 | 0 | 0.0 |
| A-2224 S.B. | 2 1/4" LSC | 2,904 | 3 | 0.1 | 0 | 0.0 |
| A-2225 N.B. | 2 1/4" LSC | 12,528 | 72 | 0.6 | 0 | 0.0 |
| A-2225 S.B. | 2 1/4" LSC | 12,528 | 19 | 0.2 | 0 | 0.0 |
| A-2227 RAMP | 2 1/4" LSC | 5,904 | 53 | 0.9 | 0 | 0.0 |
| A-2228 RAMP | 2 1/4" LSC | 5,040 | 14 | 0.3 | 0 | 0.0 |
| A-2229 RAMP | 2 1/4" LSC | 6,660 | 25 | 0.4 | 0 | 0.0 |
| A-2230 RAMP | 2 1/4" LSC | 5,916 | 74 | 1.2 | 0 | 0.0 |
| A-2231 RAMP | 2 1/4" LSC | 5,148 | 44 | 0.8 | 0 | 0.0 |
| A-2847 N.B. | 2 1/4" LSC | 2,640 | 9 | 0.4 | 0 | 0.0 |
| A-2984 S.B. | 2 1/4" LSC | 1,980 | 3 | 0.1 | 0 | 0.0 |
| A-2985 N.B. | 2 1/4" LSC | 1,932 | 2 | 0.1 | 0 | 0.0 |
| A-3128 | 2 1/4" LSC | 2,256 | 5 | 0.2 | 0 | 0.0 |
| A-3351 RAMP | 2 1/4" LSC | 3,600 | 18 | 0.5 | 0 | 0.0 |
| A-3352 RAMP | 2 1/4" LSC | 1,956 | 13 | 0.7 | 10 | 0.5 |
| A-3353 RAMP | 2 1/4" LSC | 3,504 | 42 | 1.2 | 0 | 0.0 |
| A-3547 N.B. | 2 1/4" LSC | 2,928 | 3 | 0.1 | 0 | 0.0 |
| A-3547 S.B. | 2 1/4" LSC | 2,928 | 18 | 0.6 | 0 | 0.0 |

(1) 42 additional deck driving lanes were found with delamination or patching during the 1989-90 survey and are listed above,the 42 remaining deck driving lanes had either none or <0.1% of the surveyed area effected.

## Table 8
## 1982-1983 Survey
## CORE DATA (1)

| Bridge No. & Direction | Design Thickness and Type of Overlay | No. of Winter Exposures | No. of Cap Cores | Size and Category of Cracking | Maximum Depth of Crack (In.) | Actual Depth of Overlay At Core (In.) | Penetrate Substrate Base Concrete | Core Overlay Bond | Type Aggregate Combinations |
|---|---|---|---|---|---|---|---|---|---|
| A-1763 R N&S | 1 1/2" Latex Modified Concrete | 3 | 6 | F-Diagonal | 0.8 | 1.8 | No | Yes | (3) |
| | | | | L-Longitudinal | 1.7 | 1.8 | No | Yes | (3) |
| | | | | M-Transverse | 1.7 | 1.7 | No | Yes | (3) |
| | | | | M-Transverse | 1.2 | 1.7 | No | Yes | (3) |
| | | | | M-Transverse | 1.5 | 1.6 | No | Yes | (3) |
| | | | | L-Longitudinal & Transverse | 1.9 | 1.9 | No | Yes | (3) |
| | | | | Average | 1.4 | 2.4 | | | |
| A-2117 N&S | 2 1/4" Low Slump | 2 | 6 | F-Transverse | 0.0 | 2.5 | No | Yes | (3) |
| | | | | M-Transverse | 0.6 | 2.5 | No | Yes | (3) |
| | | | | M-Transverse | 3.7 | 2.5 | Yes | Yes | (3) |
| | | | | M-Transverse | 3.7 | 2.7 | Yes | Yes | (3) |
| | | | | F-Longitudinal | 0.0 | 2.7 | No | Yes | (3) |
| | | | | F-Longitudinal | 0.4 | 2.9 | No | Yes | (3) |
| | | | | Average | 2.1 | 2.6 | | | |
| A-2225 S.B. | 2 1/4" Low Slump | 2 | 6 | F-Variable | 0.9 | 2.4 | No | Yes | (5) |
| | | | | F-Variable | 0.1 | 2.7 | No | Yes | (5) |
| | | | | F-Variable | 0.6 | 2.7 | No | Yes | (5) |
| | | | | F-Variable | 0.9 | 2.1 | No | No | (5) |
| | | | | F-Transverse & Longitudinal | 2.2 | 2.2 | No | Yes | (5) |
| | | | | F-Transverse | 3.4 | 2.1 | Yes | Yes | (5) |
| | | | | Average | 1.4 | 2.4 | | | |

(1) Of 15 bridges with cores cut in the 1982-83 survey 3 of the same bridges had cores cut in the 1989-90 survey and are included above.

17 additional cores were cut in the 1989-90 survey on 12 additional deck driving lanes primarily to determine whether debonded at the overlay interface with the base deck concrete or fracture planed within the base deck concrete at the level of the top reinforcing steel and incidently to determine the depth of surface crack penetration in the overlay and base deck concrete and are included on the proceeding pages.

# Table 8A
# 1989-1990 Survey
# CORE DATA (1)

| Bridge No. & Direction | Design Thickness and Type of Overlay | No. of Winter Expo-sures | No. of Cap Cores | Size and Category of Cracking | Maximum Depth of Crack (In.) | Actual Depth of Overlay At Core (In.) | Penetrate Substrate Base Concrete | Core Overlay Bond | Type Aggregate Combinations |
|---|---|---|---|---|---|---|---|---|---|
| A-1763 R Ramp | 1 1/2" Latex | 10 | 4 | None | None | 1.7 | No | Yes | (3) |
| | Modified Concrete | | | | | | | (Fracture Planed) | |
| | Modified Concrete | | | M-Transverse | 1.5 | 1.7 | No | No | (3) |
| | | | | None | None | 1.7 | No | No | (3) |
| | | | | None | None | 1.7 | No | Yes | (3) |
| | | | | | | | | (Fracture Planed at patch in base deck) | |
| A-2117 N&S | 2 1/4" Low Slump | 9 | 1 | None | None | 2.8 | No | No | (3) |
| A-2225 S.B. | 2 1/4" Low Slump | 8 | 1 | None | None | 2.3 | No | No | (5) |
| A-2225 N.B. | 2 1/4" Low Slump | 8 | 1 | F-Longitudinal | 0.4 | 2.3 | No | No | (5) |

(1) Of 15 bridges with cores cut in the 1982-83 survey 3 of the same bridges had cores cut in the 1989-90 survey and are included above.

17 additional cores were cut in the 1989-90 survey on 12 additional deck driving lanes primarily to determine whether debonded at the overlay interface with the base deck concrete or fracture planed within the base deck concrete at the level of the top reinforcing steel and incidently to determine the depth of surface crack penetration in the overlay and base deck concrete and are included on the proceeding pages.

## Table 8A (Continued)
## 1989-1990 Survey
## CORE DATA (1)

| Bridge No. & Direction | Design Thickness and Type of Overlay | No. of Winter Expo-sures | No. of Cap Cores | Size and Category of Cracking | Maximum Depth of Crack (In.) | Actual Depth of Overlay At Core (In.) | Penetrate Substrate Base Concrete | Core Overlay Bond | Type Aggregate Combinations |
|---|---|---|---|---|---|---|---|---|---|
| A-1643R W.B. | 1 1/2" Latex Concrete | 9 | 3 | None | None | 1.9 | No | Yes | (3) |
| | | | | M-Longitudinal | 1.7 | 2.0 | No | Yes (Fracture Planed) | (3) |
| | | | | None | None | 1.7 | No | No | (3) |
| A-2230 | 2 1/4" Low Slump | 8 | 1 | F-Longitudinal | 0.3 | 2.5 | No | No | (5) |
| A-2231 | 2 1/4" Low Slump | 8 | 1 | None | None | 1.7 | No | No | (5) |
| A-2232 | 2" Low Slump | 8 | 1 | F-Longitudinal | 0.5 | 2.1 | No | No | (5) |
| A-2682 S.B. | 1" Latex Mortar | 13 | 1 | M-Transverse | 2.4 | 1.2 | No | No (Fracture Planed) | (1) |
| A-2847 | 2 1/4" Low Slump | 9 | 1 | None | None | 2.1 | No | Yes | (5) |
| A-3520 | 2" Low Slump | 12 | 2 | None | None | 2.1 | No | No | (5) |
| | | | | None | None | 2.1 | No | No | (5) |

(1) Of 15 bridges with cores cut in the 1982-83 survey 3 of the same bridges had cores cut in the 1989-90 survey and are included on the preceeding pages.

17 additional cores were cut in the 1989-90 survey on 12 additional deck driving lanes primarily to determine whether debonded at the overlay interface with the base deck concrete or fracture planed within the base deck concrete at the level of the top reinforcing steel and incidently to determine the depth of surface crack penetration in the overlay and base deck concrete and are included above.

# Table 8A (Continued)
## 1989-1990 Survey
## CORE DATA (1)

| Bridge No. & Direction | Design Thickness and Type of Overlay | No. of Winter Expo-sures | No. of Cap Cores | Size and Category of Cracking | Maximum Depth of Crack (In.) | Actual Depth of Overlay At Core (In.) | Penetrate Substrate Base Concrete | Core Overlay Bond | Type Aggregate Combinations |
|---|---|---|---|---|---|---|---|---|---|
| L-319R E.B. | 2" Low Slump | 9 | 1 | None | None | 2.0 | No | No | (5) |
| L-501R | 1 3/4" Low Slump | 12 | 1 | None | None | 2.2 | No | No (Fracture Planed) | (5) |
| L-641R | 1 1/2" Latex Concrete | 12 | 1 | None | None | 2.7 | No | No | (4) |
| L-642R | 1 3/4" Low Slump | 12 | 2 | None | None | 2.1 | No | No | (5) |
| | | | | None | None | 2.0 | No | Yes | (5) |
| L-759R | 1 1/2" Latex Concrete | 12 | 3 | F-Longitudinal | 0.4 | 1.7 | No | Yes (Fracture Planed) | (4) |
| | | | | None | None | 1.7 | No | No | (4) |
| | | | | M-Transverse | 0.8 | 1.7 | No | No | (4) |

(1) Of 15 bridges with cores cut in the 1982-83 survey 3 of the same bridges had cores cut in the 1989-90 survey and are included on the preceeding pages.

17 additional cores were cut in the 1989-90 survey on 12 additional deck driving lanes primarily to determine whether debonded at the overlay interface with the base deck concrete or fracture planed within the base deck concrete at the level of the top reinforcing steel and incidently to determine the depth of surface crack penetration in the overlay and base deck concrete and are included above.

## Table 8A (Continued)

General: Type of Aggregate Combinations

(1) A Meramec sand aggregate mortar overlay over a crushed limestone aggregate substrate concrete deck.
(2) A Meramec sand aggregate mortar overlay over a Meramec gravel aggregate substrate concrete deck.
(3) A crushed limestone aggregate overlay over a crushed limestone aggregate substrate concrete deck.
(4) A Meramec gravel aggregate concrete overlay over a crushed limestone aggregate substrate concrete deck.
(5) A crushed porphyry aggregate concrete overlay over a crushed limestone aggregate substrate concrete deck.
(6) A crushed limestone aggregate overlay over a lightweight aggregate substrate concrete deck.
(7) A crushed limestone aggregate overlay over either a Meramec or Black River Gravel aggregate substrate concrete deck.
(8) A Meramec gravel aggregate concrete overlay over a Meramec gravel aggregate substrate concrete deck.

For the purpose of this study, size of cracks are defined as follows:

| Type Crack | Description | Can Be Seen From |
|---|---|---|
| Fine | Very Tight | $\leq$ 5' |
| Medium | Sharp Edged | > 5' |
| Large | Edges Rounded | > 5' |

Maximum depth of surface crack(vertical penetration) as measured on each of the individual drilled cores.

R=Rehabilitated Bridge Deck
O.R. = Outer Roadway

## Table 9

## SUMMARY DATA OF PERTINENT INFORMATION RELATING TO THE DECK AND OVERLAYS

| Bridge No. and Direction | Route No. | County | 1982 ADT | 1989 ADT | Class of Base Concrete In Deck | Deck Rehabilitated or Of New Construction | Deck Constructed (Mos/Yr) | Thickness and Type Of Overlay | Overlay Constructed (Mos/Yr) | Coarse Aggregate Overlay Vs. Bridge Deck |
|---|---|---|---|---|---|---|---|---|---|---|
| L-887R W.B. | (Not Surveyed in 1989-1990 Study, redecked in 1985 with Cathodic Protection) | | | | | | | | | |
| L-887R E.B. | (Not Surveyed in 1989-1990 Study, redecked in 1985 with Cathodic Protection) | | | | | | | | | |
| A-93R W.B. | I-70 | STLO | 37,979 | 59,200 | B-1 | R/NC | 57/JUL 79 | 1 1/2" LC | AUG 79 | (3) |
| A-93R E.B. | I-70 | STLO | 43,224 | 59,200 | B-1 | R/NC | 57/JUL 79 | 1 1/2" LC | JUL 80 | (3) |
| A-1310R S.B. | ELLIS BLVD. | COLE | 10,460 | 13,846 | B-2 | R/NC | AUG 81 | 1 1/2" LC | OCT 81 | (3) |
| A-1310R N.B. | ELLIS BLVD. | COLE | 10,460 | 13,846 | B-2 | R/NC | SEP 81 | 1 1/2" LC | OCT 81 | (3) |
| *A-1643R W.B. | BANNISTER RD. | JACK | 3,900 | 15,064 | B-1 | R | 67/JUL 80 | 1 1/2" LC | JUL 80 | (3) |
| A-1643R E.B. | BANNISTER RD. | JACK | 3,900 | 16,637 | B-2 | R/NC | 80/JUL 80 | 1 1/2" LC | JUL 80 | (3) |
| *A-1763R RAMP | I-29 | CLAY | 4,800 | 5,500 | B-1 | R/NC | 69/MAY 79 | 1 1/2" LC | JUN 79 | (3) |
| A-3085 N.B. | 61 | STLO | 15,653 | 18,439 | B-1 | NC | JUN 78 | 1 1/2" LC | JUL 78 | (3) |
| *A-3085 S.B. | 61 | STLO | 15,653 | 19,172 | B-1 | NC | AUG 79 | 1 1/2" LC | SEP 79 | (4) |
| A-3623 E.B. | 160 | GREE | 5,960 | 5,969 | B-1 | NC | AUG 79 | 1 1/2" LC | OCT 79 | (3) |
| *A-3623 W.B. | 160 | GREE | 5,960 | 5,969 | B-1 | NC | JUN 79 | 1 1/2" LC | OCT 79 | (3) |
| *A-3735 RAMP | 40 | STLO | 28,290 | 28,300 | B-1 | NC | OCT 78 | 1 1/2" LC | OCT 78 | (4) |
| A-3808 RAMP | I-170 | STLO | 9,800 | 9,800 | B-1 | NC | JUN 79 | 1 1/2" LC | JUL 79 | (3) |
| A-3809 RAMP | I-170 | STLO | 9,200 | 14,000 | B-1 | NC | APR 79 | 1 1/2" LC | JUN 79 | (3) |
| *A-3810 OREB | I-170 | STLO | 3,400 | 3,400 | B-1 | NC | NOV 78 | 1 1/2" LC | NOV 78 | (4) |
| A-3823 E.B. | I-270 | STLO | 38,832 | 66,862 | B-2 | NC | SEP 80 | 1 1/2" LC | OCT 80 | (3) |
| J-493R OR E.B. | I-270 | STLO | 800 | 1,000 | X & B-1 | R/NC | 31/AUG 79 | 1 1/2" LC | AUG 79 | (3) |
| *J-991R W.B. | 40 | STCH | 5,735 | 12,353 | X & B-1 | R/NC | 35/AUG 77 | 1 1/2" LC | SEP 77 | (4) |
| *L-641R S.B. | I-35 | CLAY | 12,044 | 19,297 | B-1 | R/NC | 55/NOV 77 | 1 1/2" LC | NOV 77 | (4) |

O.R. = Outer Roadway

## Table 9 (Continued)

### SUMMARY DATA OF PERTINENT INFORMATION RELATING TO THE DECK AND OVERLAYS

| Bridge No. and Direction | Route No. | County | 1982 ADT | 1989 ADT | Class of Base Concrete In Deck | Deck Rehabilitated or Of New Construction | Deck Constructed (Mos/Yr) | Thickness and Type Of Overlay | | Overlay Constructed (Mos/Yr) | Coarse Aggregate Overlay Vs. Bridge Deck |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L-669R | 40 | STLO | 21,074 | 51,808 | B-1 | NC | OCT 78 | 1 1/2" | LC | OCT 78 | (4) |
| *L-759 S.B. | I-35 | CLAY | 12,921 | 17,716 | B-1 | R/NC | 58/NOV 77 | 1 1/2" | LC | NOV 77 | (4) |
| A-3005 E.B. | I-70 | STLO | 43,833 | 60,732 | B-1 | NC | JUL 80 | 1 3/4"-2" | LC | JUL 80 | (3) |
| *L-717R W.B. | I-270 | STLO | 38,831 | 64,343 | B-2 | NC | APR 80 | 1 3/4" | LC | NOV 80 | (3) |
| L-717R E.B. | I-270 | STLO | 38,831 | 66,862 | B-2 | R | OCT 80 | 1 3/4" | LC | NOV 80 | (3) |
| ~~A-211R E.B.~~ | I-270 | STLO | 38,832 | 69,492 | **B-1 & B-2 | R/NC | AUG 80 | 2" | LC | NOV 80 | (3) |
| ~~A-3824 E.B.~~ | I-270 | STLO | 42,010 | 66,862 | B-2 | NC | SEP 80 | 2" | LC | NOV 80 | (3) |
| *A-3004 E.B. | I-70 | STLO | 43,833 | 60,372 | B-1 | NC | JUN 80 | 2 1/4" | LC | JUL 80 | (3) |
| *A-2672 N.B. | 141 | JEFF | 8,660 | 11,356 | B-1 | NC | MAY 77 | 1" | LM | AUG 77 | (1) |
| *A-2672 S.B. | 141 | JEFF | 8,660 | 9,052 | B-1 | NC | AUG 77 | 1" | LM | AUG 77 | (1) |
| A-2682 N.B. | 141 | STLO | 14,874 | 16,000 | B-1 | NC | AUG 76 | 1" | LM | OCT 76 | (1) |
| *A-2682 S.B. | 141 | STLO | 14,875 | 16,000 | B-1 | NC | AUG 76 | 1" | LM | OCT 76 | (1) |
| A-2683 N.B. | 141 | JEFF | 7,908 | 13,396 | B-1 | NC | SEP 76 | 1" | LM | OCT 76 | (1) |
| *A-2683 S.B. | 141 | JEFF | 7,908 | 12,405 | B-1 | NC | SEP 76 | 1" | LM | OCT 76 | (1) |
| A-2684 N.B. | 141 | JEFF | 8,600 | 13,396 | B-1 | NC | SEP 76 | 1" | LM | OCT 76 | (1) |
| A-2684 S.B. | 141 | JEFF | 7,908 | 12,405 | B-1 | NC | SEP 76 | 1" | LM | OCT 76 | (1) |
| *A-2738 S.B. | 109 | STLO | 2,960 | 13,396 | B-1 | NC | APR 76 | 1" | LM | MAY 76 | (2) |
| *L-501R S.B. | I-35 | CLAY | 17,018 | 21,756 | B-1 | R/NC | 58/NOV 77 | 1 3/4" | LSC | NOV 77 | (5) |
| *L-642R N.B. | I-35 | CLAY | 13,316 | 19,299 | B-1 | R/NC | 55/NOV 77 | 1 3/4" | LSC | DEC 77 | (5) |
| *A-119R E.B. | 140TH STREET | JACK | 9,000 | 9,000 | B-1 | R/NC | 61/JUL 79 | 2" | LSC | NOV 79 | (5) |
| *A-2232 RAMP | I-229 | BUCH | 4,000 | 9,000 | B-1 | NC | MAR 81 | 2" | LSC | MAY 81 | (5) |

**B-1 on part (3' Approx.); B-2 on (9'Approx.), A widened d eck.

## Table 9 (Continued)

## SUMMARY DATA OF PERTINENT INFORMATION RELATING TO THE DECK AND OVERLAYS

| Bridge No. and Direction | Route No. | County | 1982 ADT | 1989 ADT | Class of Base Concrete In Deck | Deck Rehabilitated or Of New Construction | Deck Constructed (Mos/Yr) | Thickness and Type Of Overlay | Overlay Constructed (Mos/Yr) | Coarse Aggregate Overlay Vs. Bridge Deck |
|---|---|---|---|---|---|---|---|---|---|---|
| A-2233 RAMP | 36 | BUCH | 4,000 | 4,500 | B-1 | NC | OCT 80 | 2" LSC | APR 81 | (5) |
| A-2234 RAMP | 36 | BUCH | 4,100 | 6,400 | B-1 | NC | JUN 80 | 2" LSC | APR 81 | (5) |
| A-2235 RAMP | 36 | BUCH | 8,400 | 8,500 | B-1 | NC | JUL 80 | 2" LSC | APR 81 | (5) |
| A-3047 N.B. | 67 | STCH-STLO | 6,330 | 10,240 | X | NC | NOV 82 | 2" LSC | MAY 83 | (6) |
| A-3047 S.B. | 67 | STCH-STLO | 6,330 | 10,200 | X | NC | NOV 82 | 2" LSC | JUN 83 | (6) |
| A-3292 E.B. | I-70 | STCH | 45,143 | 72,825 | X | NC | SEP 78 | 2" LSC | OCT 78 | (6) |
| *A-3520 E.B. | HALIFAX RD. | CALL | 500 | 800 | B-1 | NC | APR 78 | 2" LSC | JUL 78 | (3) |
| *A-3521R S.B.[(1)] | AC | CALL | 1,830 | 2,250 | B-1 | NC | APR 78 | 2 1/4" LSC | SEP 84 | (3) |
| *A-3522 E.B. | 54 | CALL | 6,420 | 7,968 | B-1 | NC | JUN 78 | 2" LSC | AUG 78 | (3) |
| A-3671 E.B. | 50 | FRAN | 4,504 | 8,086 | B-1 | NC | NOV 78 | 2" LSC | MAY 79 | (3) |
| A-3706 W.B. | 60 | BUTL | 7,210 | 2,535 | B-1 | NC | DEC 79 | 2" LSC | APR 80 | (7) |
| A-3706 E.B. | 60 | BUTL | 7,210 | 2,535 | B-1 | NC | DEC 79 | 2" LSC | APR 80 | (7) |
| A-3792 W.B. | 60 | STOD | 4,830 | 5,675 | B-1 | NC | OCT 79 | 2" LSC | MAY 80 | (7) |
| A-3792 E.B. | 60 | STOD | 4,830 | 5,675 | B-1 | NC | OCT 79 | 2" LSC | MAY 80 | (7) |
| *A-3830 E.B. | I-229 | BUCH | 10,559 | 14,483 | B-1 | NC | MAY 80 | 2" LSC | JUN 80 | (5) |
| A-3831 RAMP | 36 | BUCH | 2,400 | 2,400 | B-1 | NC | MAY 80 | 2" LSC | JUN 80 | (5) |
| L-293R S.B. | 71 | JASP | 3,033 | 4,706 | B-1 & LSC | R/NC | 50/SEP 81 | 2" LSC | OCT 81 | (3) |
| L-319R W.B. | 36 | BUCH | 10,550 | 16,010 | B-1 | NC | NOV 79 | 2" LSC | MAY 81 | (5) |
| *L-319R E.B. | 36 | BUCH | 10,550 | 14,483 | B-1 | NC | NOV 79 | 2" LSC | JUN 80 | (5) |
| A-2116 W.B. | I-470 | JACK | 3,903 | 13,281 | B-1 | NC | MAY 80 | 2 1/4" LSC | JUL 80 | (6) |
| A-2116 E.B. | I-470 | JACK | 3,975 | 11,632 | B-1 | NC | MAY 80 | 2 1/4" LSC | JUL 80 | (6) |

(1) In 1984 Bridge A-3521R had the 2" overlay originally placed in 1978 removed and a new 2 1/2" Low Slump overlay placed.

## Table 9 (Continued)

### SUMMARY DATA OF PERTINENT INFORMATION RELATING TO THE DECK AND OVERLAYS

| Bridge No. and Direction | Route No. | County | 1982 ADT | 1989 ADT | Class of Base Concrete In Deck | Deck Rehabilitated or Of New Construction | Deck Constructed (Mos/Yr) | Thickness and Type Of Overlay | Overlay Constructed (Mos/Yr) | Coarse Aggregate Overlay Vs. Bridge Deck |
|---|---|---|---|---|---|---|---|---|---|---|
| A-2984 S.B. | I-170 | STLO | 26,300 | 38,632 | B-1 | NC | MAY 79 | 2 1/4" LSC | SEP 79 | (3) |
| A-2985 N.B. | I-170 | STLO | 26,100 | 34,993 | B-1 | NC | JUN 79 | 2 1/4" LSC | SEP 79 | (3) |
| A-2986 S.B. | I-170 | STLO | 26,300 | 41,274 | B-1 | NC | JUL 79 | 2 1/4" LSC | SEP 79 | (3) |
| A-2987 N.B. | I-170 | STLO | 26,100 | 35,441 | B-1 | NC | MAY 79 | 2 1/4" LSC | SEP 79 | (3) |
| *A-3128 | LAFAYETTE AVE. | STLO | 12,000 | 12,000 | B-1 | NC | APR 79 | 2 1/4" LSC | MAY 79 | (3) |
| A-3162 W.B. | I-55 | STLO | 47,580 | 51,500 | B-1 | NC | MAY 79 | 2 1/4" LSC | JUN 79 | (3) |
| A-3351 RAMP | I-44 | STLO | 5,770 | 5,770 | B-1 | NC | OCT 79 | 2 1/4" LSC | SEP 80 | (3) |
| *A-3352 RAMP | I-44 | STLO | 5,390 | 5,400 | B-1 | NC | JUN 78 | 2 1/4" LSC | AUG 78 | (3) |
| A-3353 RAMP | I-44 | STLO | 5,900 | 5,900 | B-1 | NC | AUG 78 | 2 1/4" LSC | SEP 78 | (3) |
| A-3483 E.B. | 54 | PIKE | 4,040 | 3,961 | B-1 | NC | AUG 79 | 2 1/4" LSC | JUL 80 | (3) |
| A-3494 E.B. | 54 | PIKE | 4,040 | 4,500 | B-1 | NC | JUL 80 | 2 1/4" LSC | AUG 80 | (3) |
| A-3496 N.B. | 61 | PIKE | 5,900 | 4,728 | B-1 | NC | OCT 79 | 2 1/4" LSC | JUL 80 | (3) |
| A-3498 N.B. | 61 | PIKE | 5,900 | 4,728 | B-1 | NC | APR 80 | 2 1/4" LSC | JUL 80 | (3) |
| A-3500 N.B. | 61 | PIKE | 5,000 | 4,728 | B-1 | NC | SEP 79 | 2 1/4" LSC | JUL 80 | (3) |
| *A-3547 N.B. | MARINE AVE. | STLO | 15,000 | 18,000 | B-1 | NC | JUL 79 | 2 1/4" LSC | AUG 79 | (3) |
| *A-3547 S.B. | MARINE AVE. | STLO | 15,000 | 18,000 | B-1 | NC | JUL 79 | 2 1/4" LSC | AUG 79 | (3) |
| A-3617 N.B. | 5 | LACL | 8,103 | 16,204 | B-1 | NC | AUG 79 | 2 1/4" LSC | OCT 79 | (3) |
| *A-3617 S.B. | 5 | LACL | 8,103 | 16,204 | B-1 | NC | AUG 79 | 2 1/4" LSC | OCT 79 | (3) |

**Table 9 (Continued)**

**SUMMARY DATA OF PERTINENT INFORMATION RELATING TO THE DECK AND OVERLAYS**

| Bridge No. and Direction | Route No. | County | 1982 ADT | 1989 ADT | Class of Base Concrete In Deck | Deck Rehabilitated or Of New Construction | Deck Constructed (Mos/Yr) | Thickness and Type Of Overlay | | Overlay Constructed (Mos/Yr) | Coarse Aggregate Overlay Vs. Bridge Deck |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *A-2117 N.B. | DOUGLAS STREET | JACK | Not Available | 2,500 | B-1 | NC | NOV 79 | 2 1/4" | LSC | MAY 80 | (6) |
| *A-2117 S.B. | DOUGLAS STREET | JACK | Not Available | 2,500 | B-1 | NC | NOV 79 | 2 1/4" | LSC | MAY 80 | (6) |
| A-2118 W.B. | COLBORN RD. | JACK | Not Available | 7,600 | B-1 | NC | MAY 80 | 2 1/4" | LSC | JUN 80 | (3) |
| A-2118 E.B. | COLBORN RD. | JACK | Not Available | 7,600 | B-1 | NC | MAY 80 | 2 1/4" | LSC | JUN 80 | (3) |
| A-2119 W.B. | COLBORN RD. | JACK | 6,317 | 6,317 | B-1 | NC | APR 80 | 2 1/4" | LSC | JUN 80 | (3) |
| A-2119 E.B. | COLBORN RD. | JACK | 6,317 | 6,317 | B-1 | NC | APR 80 | 2 1/4" | LSC | JUN 80 | (3) |
| *A-2132 N.B. | I-229 | BUCH | 3,938 | 2,367 | B-1 | NC | NOV 79 | 2 1/4" | LSC | JUL 80 | (3) |
| A-2132 S.B. | I-229 | BUCH | 3,467 | 2,315 | B-1 | NC | NOV 79 | 2 1/4" | LSC | JUL 80 | (3) |
| A-2224 S.B. | I-229 | BUCH | 5,500 | 6,060 | B-1 | NC | APR 80 | 2 1/4" | LSC | JUN 80 | (5) |
| *A-2225 N.B. | I-229 | BUCH | Not Open | 6,060 | B-1 | NC | JUN 81 | 2 1/4" | LSC | AUG 81 | (5) |
| *A-2225 S.B. | I-229 | BUCH | Not Open | 5,631 | B-1 | NC | JUL 81 | 2 1/4" | LSC | SEP 81 | (5) |
| A-2226 RAMP | I-229 | BUCH | 3,100 | 3,800 | B-1 | NC | SEP 79 | 2 1/4" | LSC | AUG 80 | (5) |
| A-2227 RAMP | I-229 | BUCH | 3,100 | 3,800 | B-1 | NC | JUL 79 | 2 1/4" | LSC | MAY 80 | (5) |
| A-2228 RAMP | I-229 | BUCH | 8,500 | 8,500 | B-1 | NC | JUN 80 | 2 1/4" | LSC | JUN 81 | (5) |
| A-2229 RAMP | I-229 | BUCH | 8,500 | 8,500 | B-1 | NC | JUL 80 | 2 1/4" | LSC | JUN 81 | (5) |
| *A-2230 RAMP | I-229 | BUCH | 7,600 | 2,800 | B-1 | NC | JUL 81 | 2 1/4" | LSC | SEP 81 | (5) |
| *A-2231 RAMP | I-229 | BUCH | 7,600 | 2,800 | B-1 | NC | MAY 81 | 2 1/4" | LSC | AUG 81 | (5) |
| A-2513 W.B. | 50 | JACK | 9,580 | 9,500 | B-1 | NC | APR 80 | 2 1/4" | LSC | MAY 80 | (3) |
| A-2514 E.B. | 50 | JACK | 19,740 | 19,700 | B-1 | NC | APR 80 | 2 1/4" | LSC | MAY 80 | (3) |
| *A-2847 N.B. | I-229 | BUCH | Not Open | 6,060 | B-1 | NC | APR 80 | 2 1/4" | LSC | JUN 80 | (5) |
| A-2908 N.B. | I-170 | STLO | 17,900 | 25,775 | B-1 | NC | JUL 79 | 2 1/4" | LSC | SEP 79 | (3) |
| A-2908 S.B. | I-170 | STLO | 15,800 | 30,017 | B-1 | NC | AUG 79 | 2 1/4" | LSC | SEP 79 | (3) |
| A-3664 E.B. | 36 | BUCH | Not Open | 8,549 | B-2 | NC | NOV 83 | 2 1/4" | LSC | NOV 83 | (3) |

## Table 9 (Continued)

General: Type of Aggregate Combinations

(1) A Meramec sand aggregate mortar overlay over a crushed limestone aggregate substrate concrete deck.
(2) A Meramec sand aggregate mortar overlay over a Meramec gravel aggregate substrate concrete deck.
(3) A crushed limestone aggregate overlay over a crushed limestone aggregate substrate concrete deck.
(4) A Meramec gravel aggregate concrete overlay over a crushed limestone aggregate substrate concrete deck.
(5) A crushed porphyry aggregate concrete overlay over a crushed limestone aggregate substrate concrete deck.
(6) A crushed limestone aggregate overlay over a lightweight aggregate substrate concrete deck.
(7) A crushed limestone aggregate overlay over either a Meramec or Black River Gravel aggregate substrate concrete deck.
(8) A Meramec gravel aggregate concrete overlay over a Meramec gravel aggregate substrate concrete deck.

*These structures had either one or all of the following additional tests performed: (a) have had concrete samples taken for chloride ion analysis, (b) copper-copper sulfate half cell (voltage) readings taken, and c) some cores cut to determine the depth of surface crack penetration in the overlay and base deck concrete, and/or to determine whether debonded at the overlay interface with the base deck concrete or fracture planed within the base deck concrete at the level of the top reinforcing steel.

R=Rehabilitated Bridge Deck

TABLE 10

**GROUPMENT OF PRINCIPAL BRIDGE CLASSIFICATION BY STRUCTURE TYPE**

I. Box Beam or Girder (BB-G)

A-93R(2), A-1643R(2), and A-1763R. ( Bridges L-887R EB & WB were BB-G but were redecked with cathodic protection in 1985 and therefore not surveyed in 1989-1990.)

II. Girder (GIRD)

A-2226, A-2227, A-2228, A-2229, A-2230, A-2231, and A-3353.

III. Pony Truss (PYTR)

J-991R

IV. Slab (SLAB)

A-119R, A-211R, A-2132(2), A-2233, A-2234, A-2235, A-2986, A-2987, A-3352, A-3706(2), A-3792(2), A-3830, A-3831, and L-759R

V. Stringer/Multi-Beam or Girder (STRG)

A-1310R(2), A-2116(2), A-2117(2), A-2118(2), A-2119(2), A-2224, A-2225(2), A-2232, A-2513, A-2514, A-2672(2), A-2682(2), A-2683(2), A-2684(2), A-2738, A-2847, A-2908(2), A-2984, A-2985, A-3004, A-3005, A-3047(2), A-3085(2), A-3128, A-3162, A-3351, A-3483, A-3494, A-3496, A-3498, A-3500, A-3520, A-3521, A-3522, A-3547(2), A-3617(2), A-3623(2), A-3664, A-3671, A-3735, A-3808, A-3809, A-3810, A-3823, A-3824, L-293R, L-319R(2), L-641R, L-642R, L-501R, and L-717R(2).

VI. Tee Beam (T-BM)

J-493R and L-669R

VII. Tru Truss (THTR)

A-3292

General: The number in ( ) indicates the number of driving (traffic) lanes investigated on this given structure.

R = Rehabilitated Bridge Deck

Table 10 (Continued)
1982-1983 Survey

TOTALS OF ABOVE BY STRUCTURE TYPE

| | |
|---|---|
| Box Beam or Girder (BB-G) | 5 |
| Girder (GIRD) | 9 |
| Pony Truss (PYTR) | 1 |
| Slab (SLAB) | 16 |
| Stringer/Multi-Beam or Girder (STRG) | 68 |
| Tee Beam (T-BM) | 2 |
| Thru Truss (THTR) | 1 |
| | 104 |

**Table 10A**
**1989-1990 Survey**

**TOTALS OF ABOVE BY STRUCTURE TYPE**

| | |
|---|---|
| Box Beam or Girder (BB-G) | **5** |
| Girder (GIRD) | **7** |
| Pony Truss (PYTR) | **1** |
| Slab (SLAB) | **17** |
| Stringer/Multi-Beam or Girder (STRG) | **69** |
| Tee Beam (T-BM) | **2** |
| Thru Truss (THTR) | **1** |
| | **102** |

Table 11
1982-1983 Survey

SUMMARY OF OVERLAYS BUILT BY TYPE AND YEAR INSTALLED

| Type of Overlay | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Latex Mortar | -- | -- | -- | 7 | 2 | -- | -- | -- | -- | -- | -- | 9 |
| Latex Concrete | 1 | 1 | -- | -- | 3 | 5 | 8 | 10 | 2 | -- | -- | 30 |
| Low Slump Concrete | -- | -- | -- | -- | 2 | 7 | 13 | 29 | 12 | -- | 2 | 65 |
| Totals by Year | 1 | 1 | -- | 7 | 7 | 12 | 21 | 39 | 14 | -- | 2 | 104 |

**Table 11A**
**1989-1990 Survey**

**SUMMARY OF OVERLAYS BUILT BY TYPE AND YEAR INSTALLED**

| Type of Overlay | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Latex Mortar | -- | -- | -- | 7 | 2 | -- | -- | -- | -- | -- | -- | -- | 9 |
| Latex Concrete | 0[(1)] | 0[(1)] | -- | -- | 3 | 4 | 8 | 10 | 2 | -- | -- | -- | 27 |
| Low Slump Concrete | -- | -- | -- | -- | 2 | 5 | 14 | 29 | 12 | -- | 2 | 1[(2)] | 66 |
| Totals by Year | 0[(1)] | 0[(1)] | -- | 7 | 7 | 9 | 22 | 39 | 14 | -- | 2 | 1[(2)] | 102 |

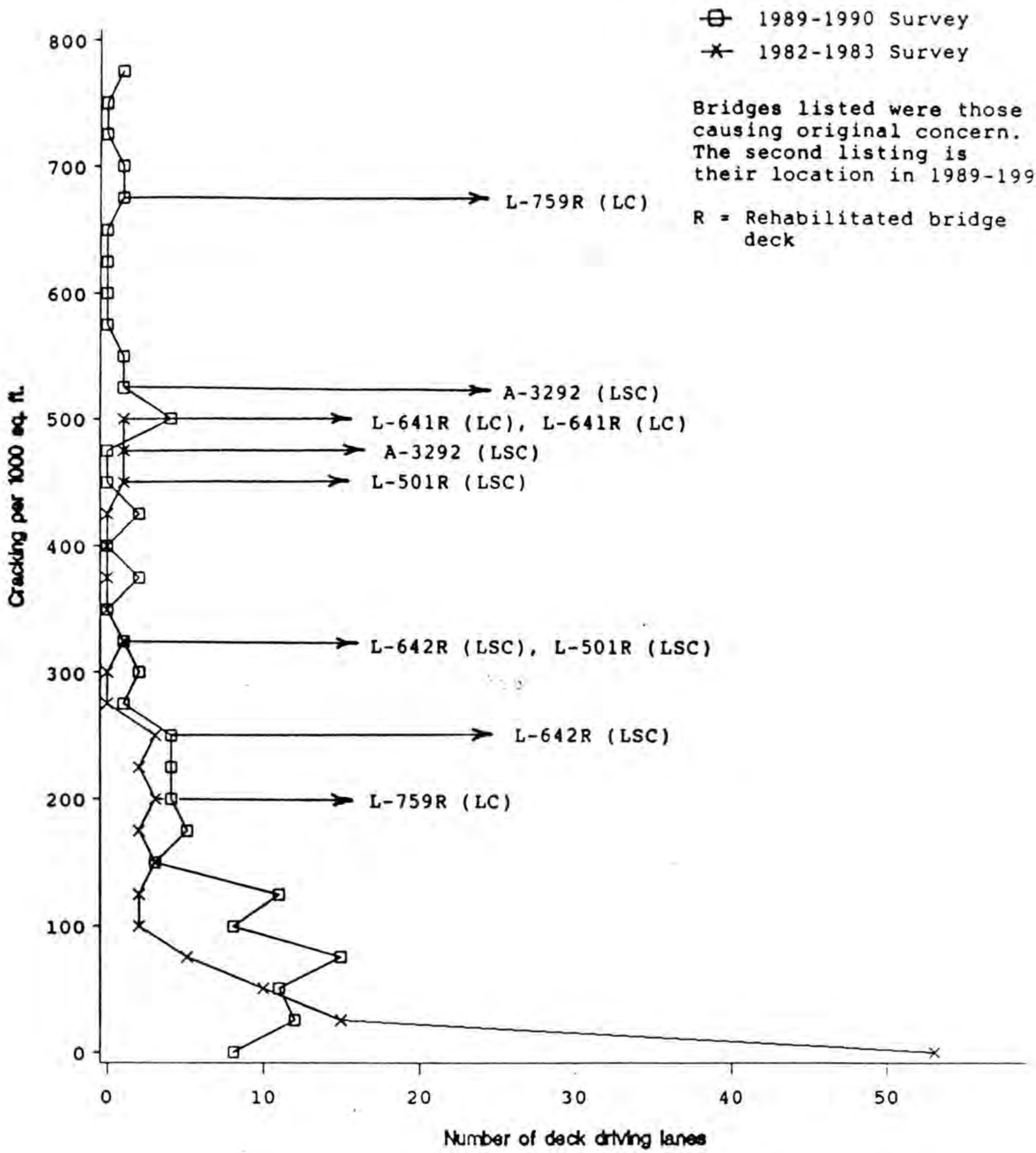
(1) Bridges L-887R EB and L-887R WB were redecked with Cathodic Protection in 1985 and therefore not surveyed in 1989-90.
(2) In 1984 Bridge A-3521R had the 2" overlay originally placed in 1978 removed and a new 2 1/2" Low Slump overlay placed.

Figure 1

Mean Freezing Index Contours
(Freezing Index Values Expressed in Degree-Days Below 32°F.)


Note: Basis of contoured data, as shown, was taken from official climatological publications covering a series of official weather stations for a period of 25 or more years.

# Figure 1
Surface Cracking Histogram



APPENDICES

I. Pages a through c inclusive contain pairs of photographic prints covering a series of cores exhibiting and documenting size of surface crack (plan view) and depth of crack penetration (profile view) from the 1982-1983 survey. Pages d through f are of cores from the 1989-1990 survey.

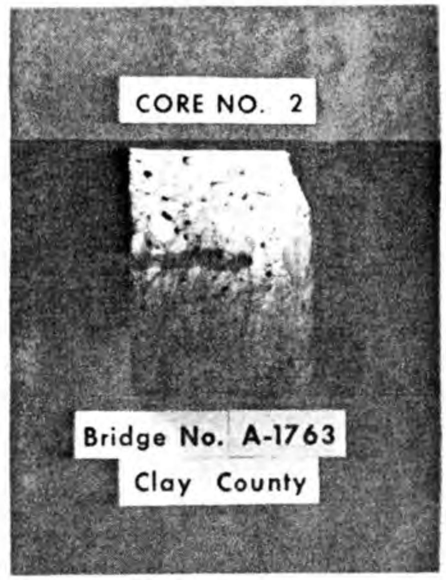
II. Pages g through j inclusive contain a series of three photographic prints of (4' x 3') grids exhibiting examples of the various categories of lineal surface cracking. These various groupings are intended to present to the viewer a visual image of some of the patterns and quantities of cracking that was the basis of tabulating and evaluating quantitatively data for Tables 1 and 6 respectively.

III. Page k contains the additional length limiting criteria as set up for the driving lane/s of each bridge deck overlay investigated.

IV. Pages l through 0 contain a complete list of all bridges with latex (latex concrete or latex mortar) and low slump overlays contained on state maintained highways in Missouri as of January 1, 1990.

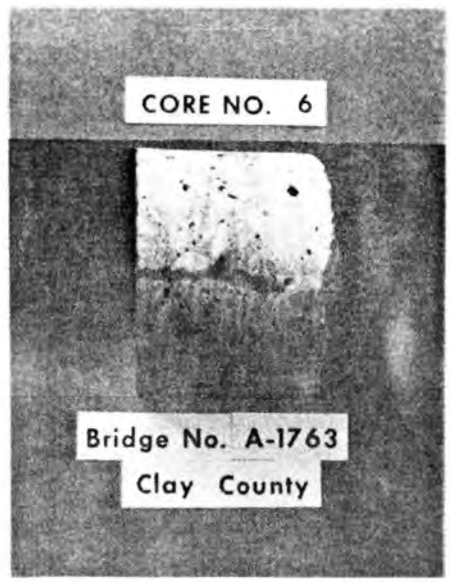
SURFACE CRACKING AND DEPTH OF PENETRATION
(1982-1983 Survey)


1.8" Latex Concrete
Large Crack
Depth 1.7"



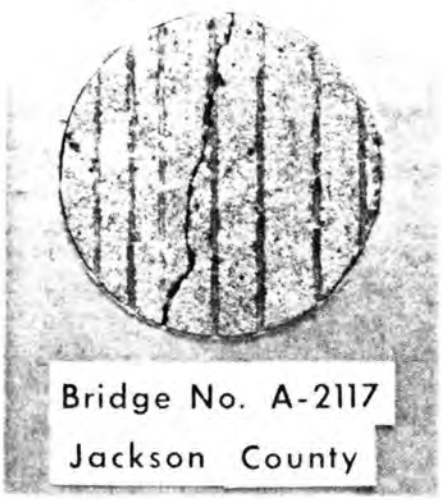


1.9" Latex Concrete
Large Crack
Depth 1.9"

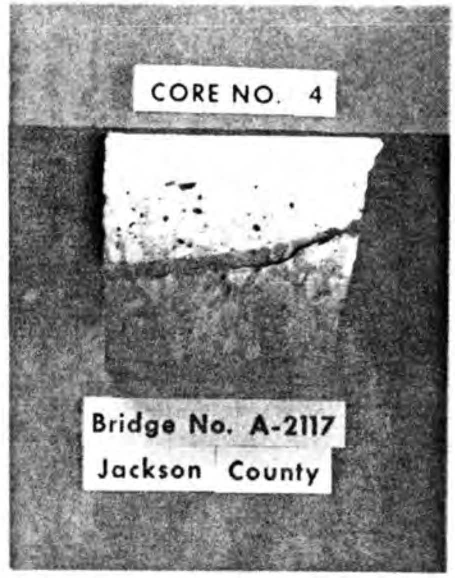


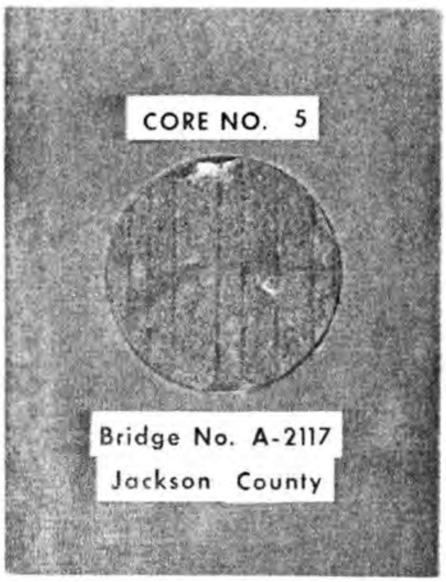
## SURFACE CRACKING AND DEPTH OF PENETRATION
(1982-1983 Survey)

CORE NO. 4

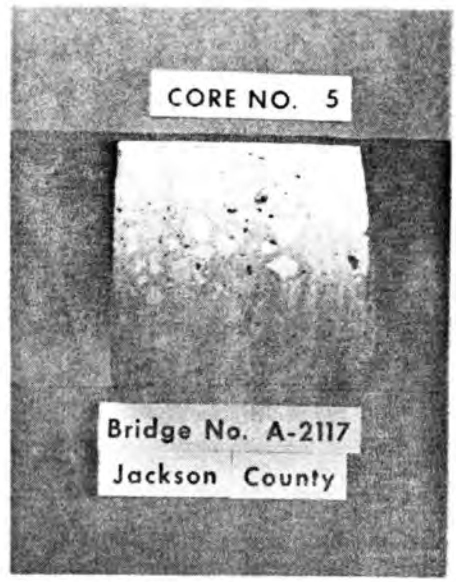


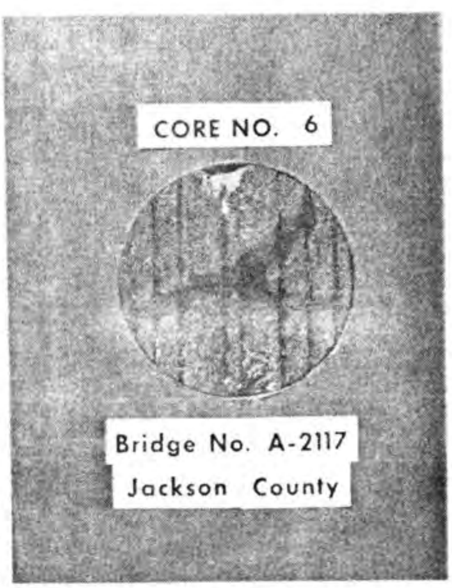

2.7" Low Slump
Medium Crack
Depth 3.7"



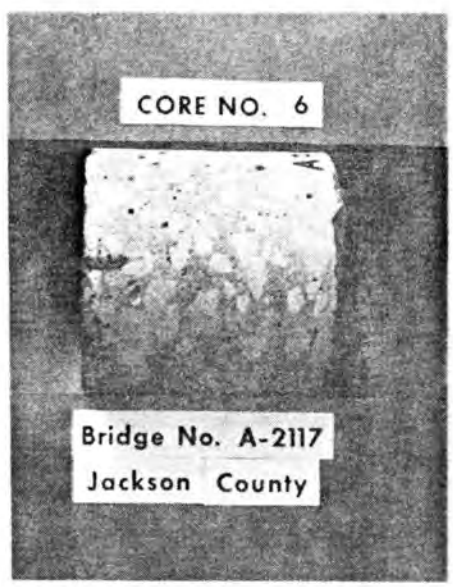




2.7" Low Slump
Fine Crack
Depth 0.0"

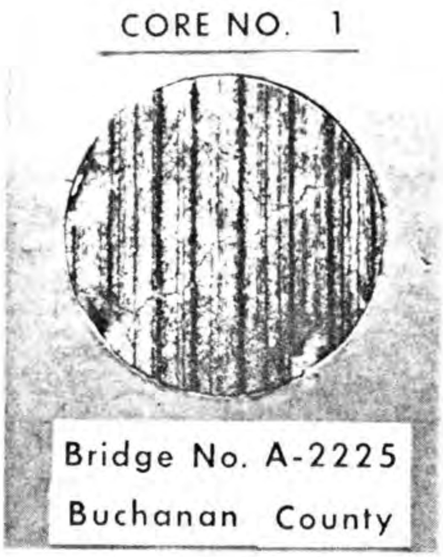


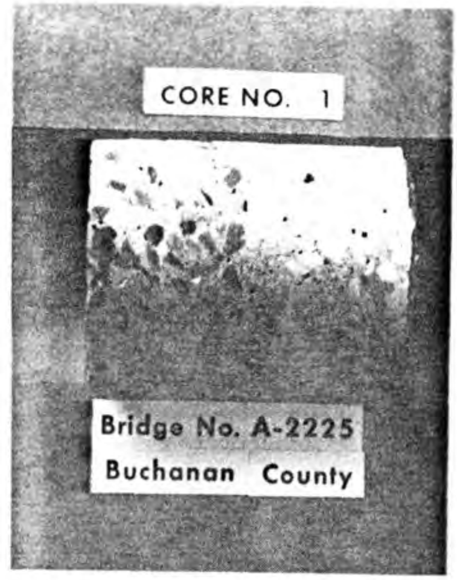

2.9" Low Slump
Fine Crack
Depth 0.4"



SURFACE CRACKING AND DEPTH OF PENETRATION
(1982-1983 Survey)

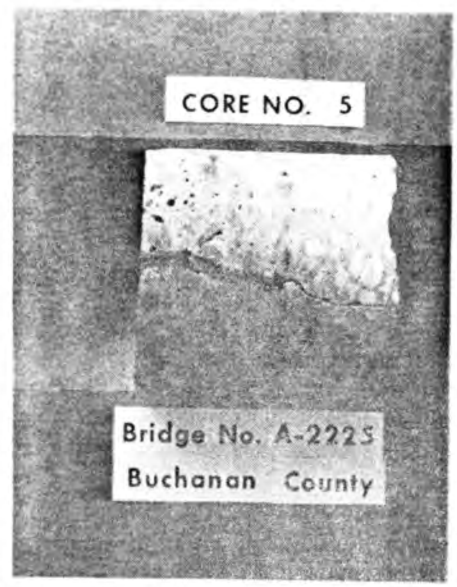


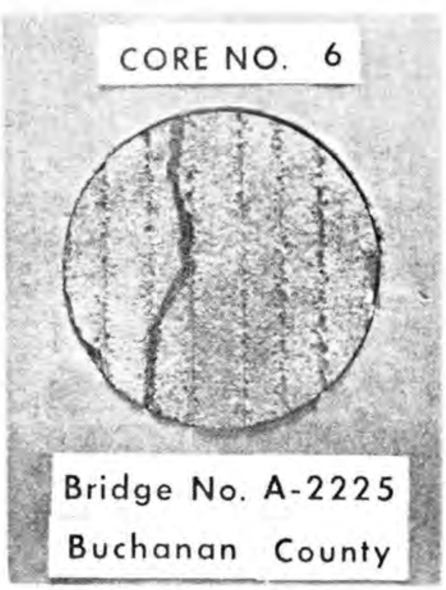

2.4" Low Slump
Fine Crack
Depth 0.9"



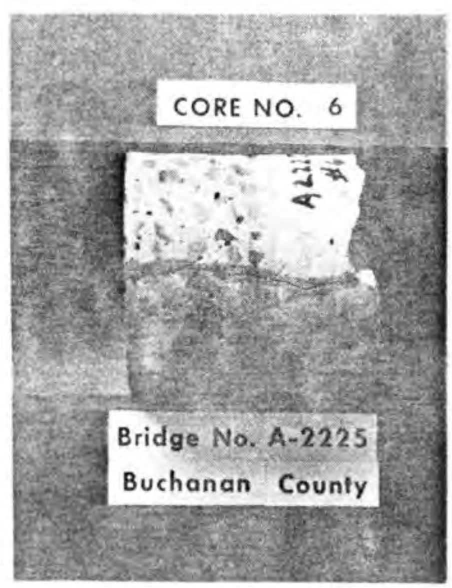


2.2" Low Slump
Fine Crack
Depth 2.2"

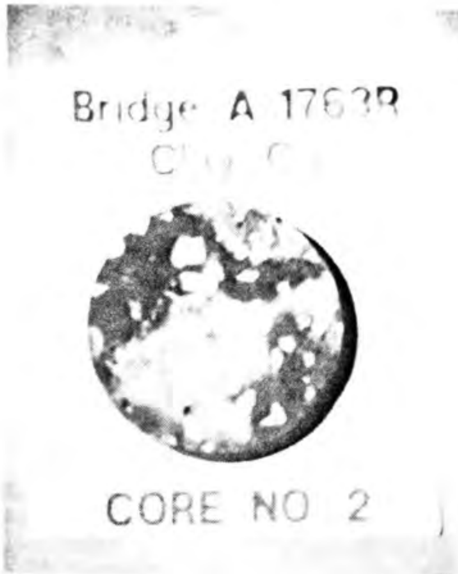


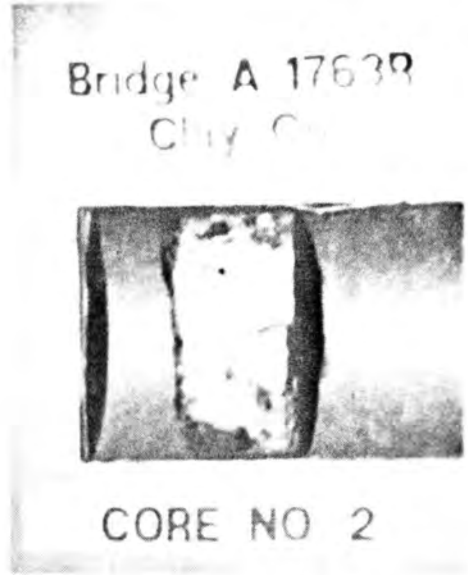

2.1" Low Slump
Fine Crack
Depth 3.4"+



## SURFACE CRACKING AND DEPTH OF PENETRATION
(1989-1990 Survey)

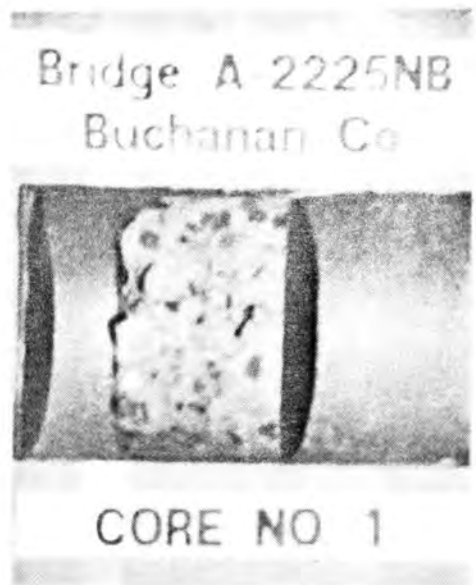



1.7" Latex Concrete
Medium Crack
Depth 1.5"





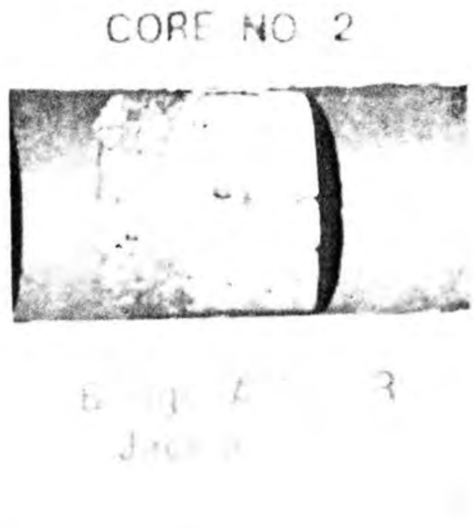
2.3" Low Slump
Fine Crack
Depth 0.4"



Appendix I

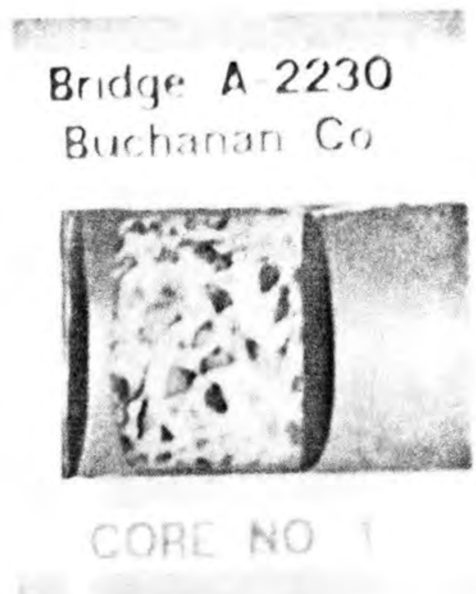
## SURFACE CRACKING AND DEPTH OF PENETRATION
(1989-1990 Survey)

2.0" Latex Concrete
Medium Crack
Depth 1.7"



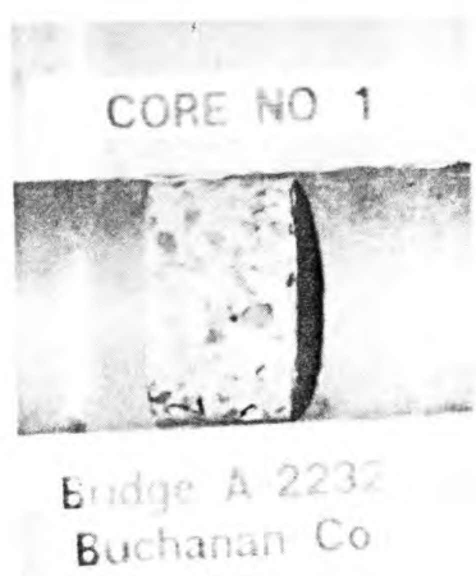


2.5" Low Slump
Fine Crack
Depth 0.3"



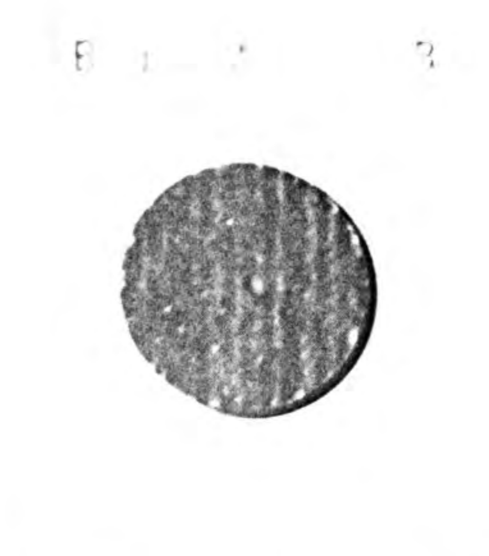


2.1" Low Slump
Fine Crack
Depth 0.5"

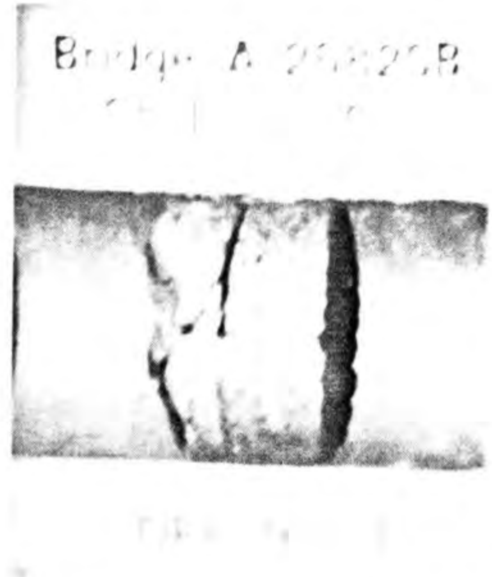


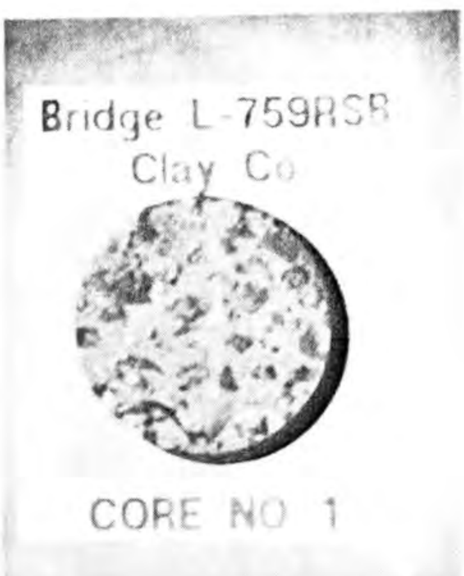
Appendix I

SURFACE CRACKING AND DEPTH OF PENETRATION
(1989-1990 Survey)

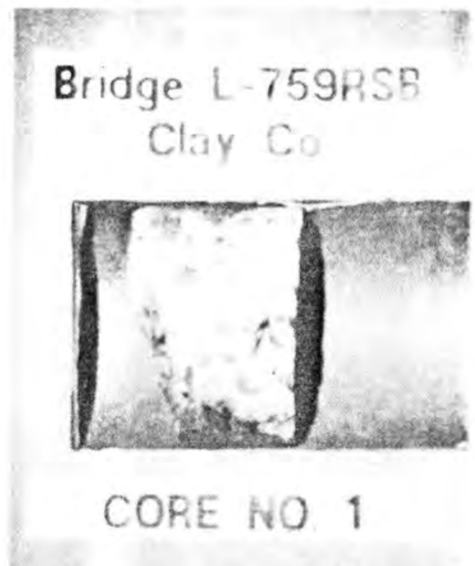


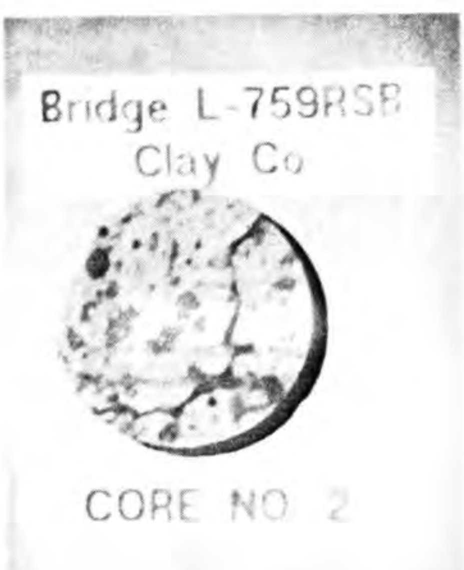
1.2" Latex Mortar
Medieum Crack
Depth 2.4"





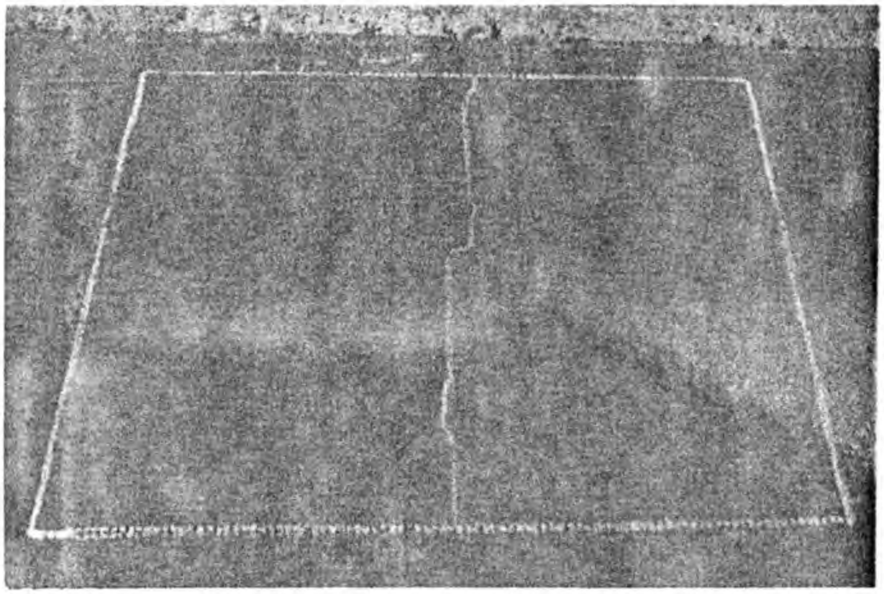

1.7" Latex Concrete
Fine Crack
Depth 0.4"



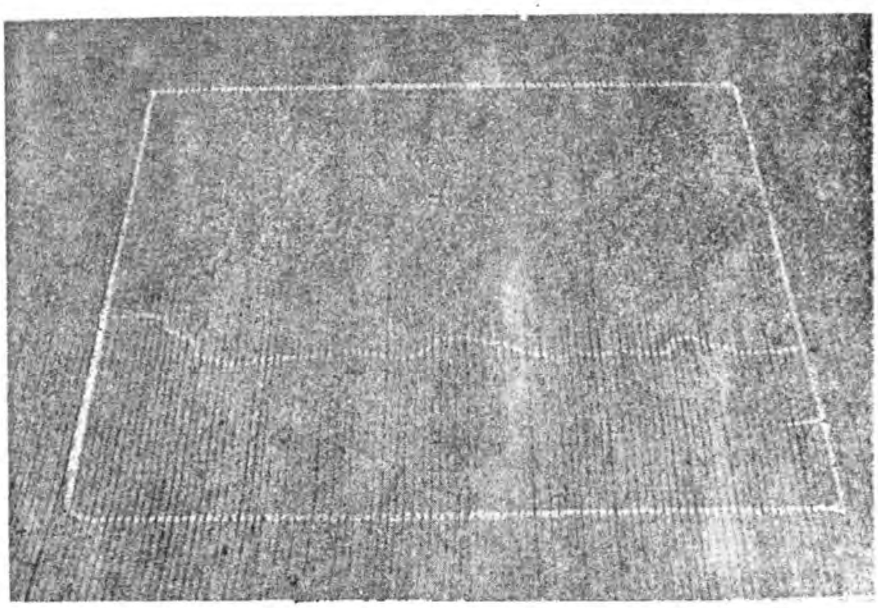

1.7" Latex Concrete
Large Crack
Depth 0.6"

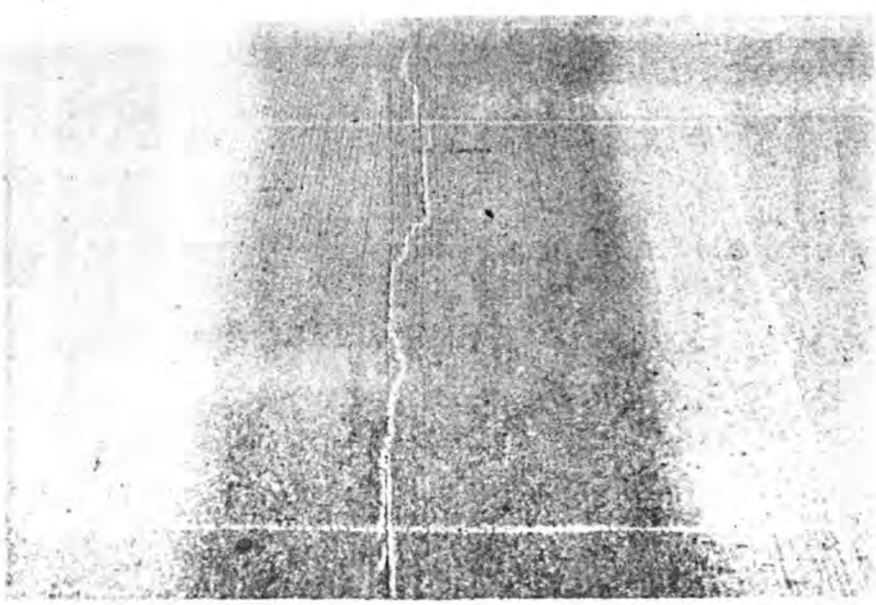
APPENDIX II



'>0 to ≤5'

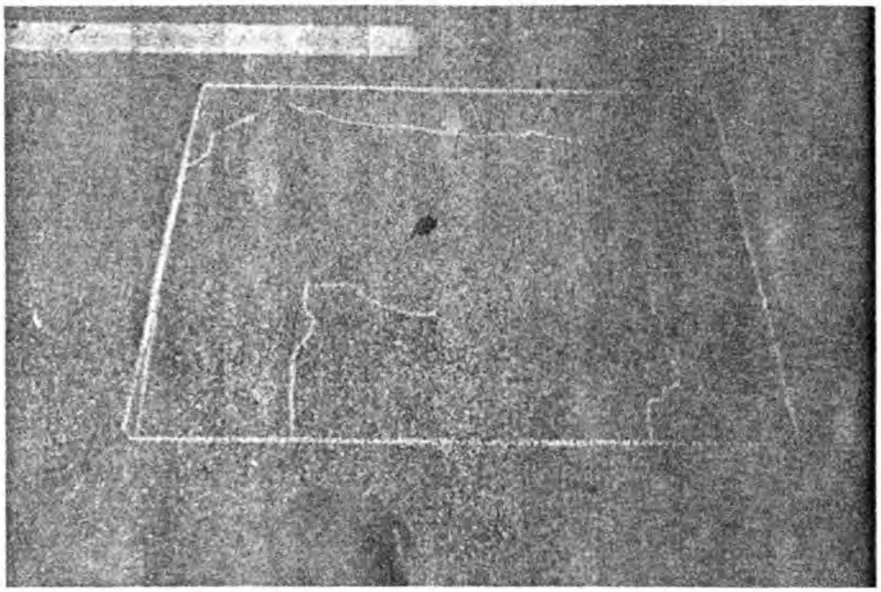
'>0 to ≤5'





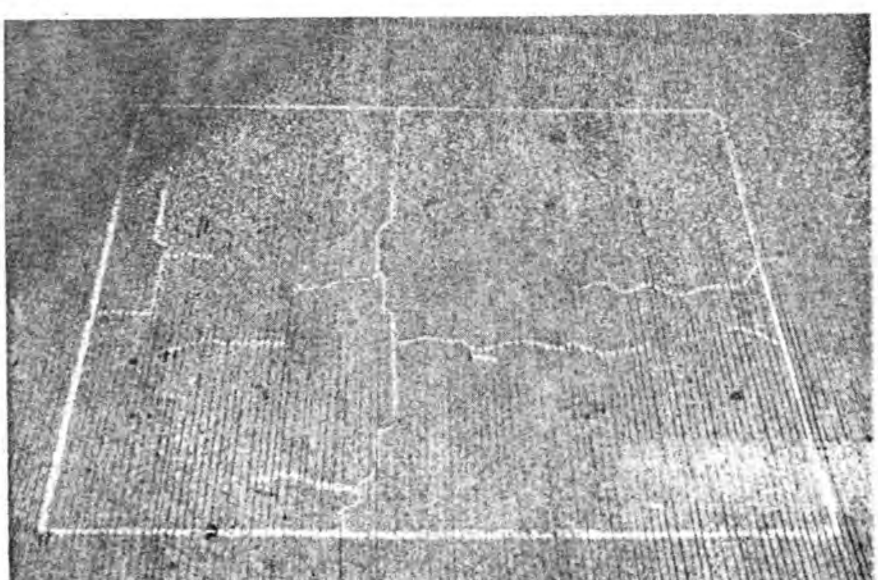
>0 to ≤5'

LEGEND: Grids are all (4 x 3) feet.



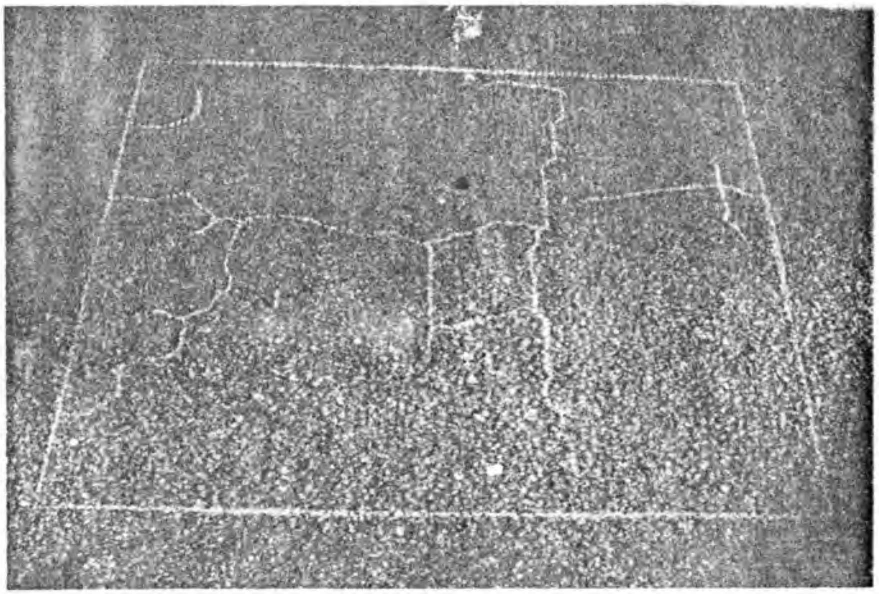
>5 to ≤10'

>5 to ≤10'

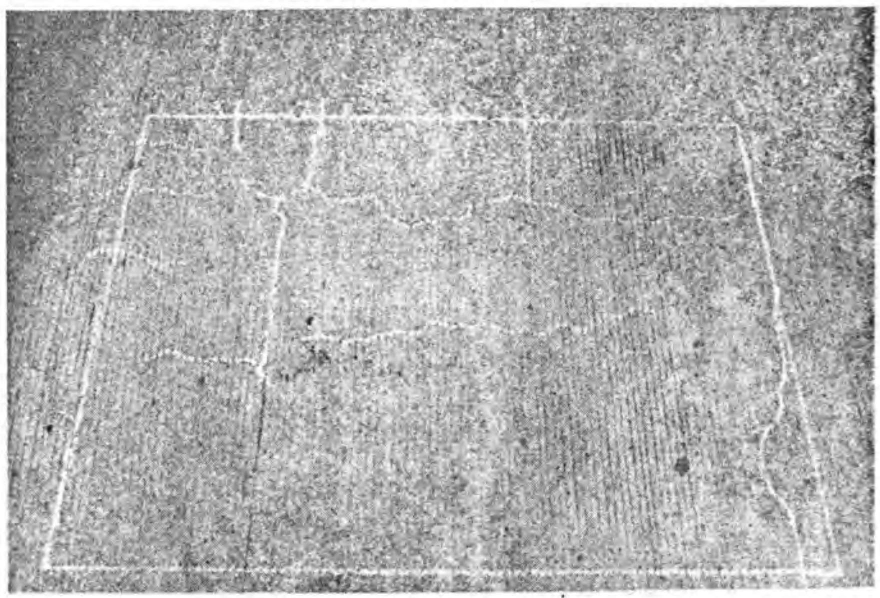


>5 to ≤10'

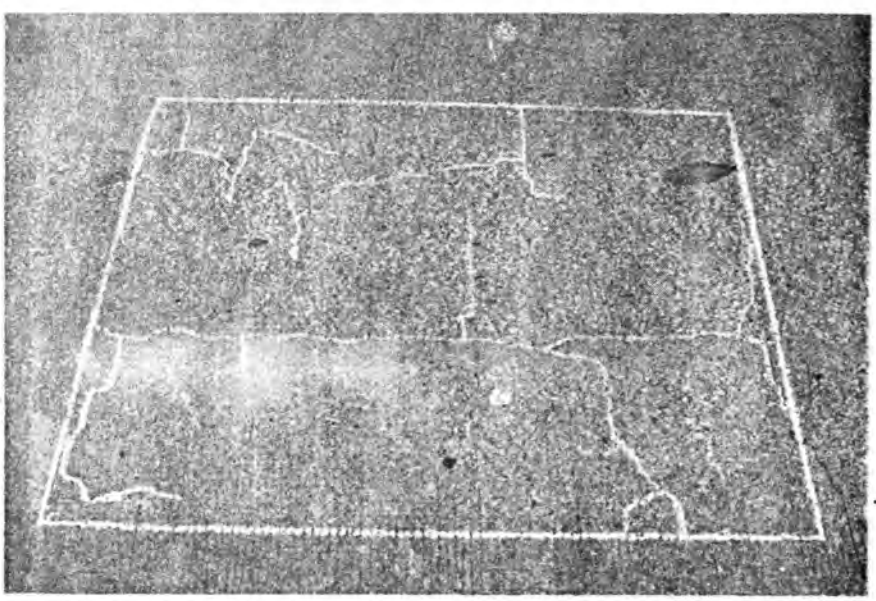
LEGEND: Grids are all (4 x 3) feet.



>10 to ≤15'



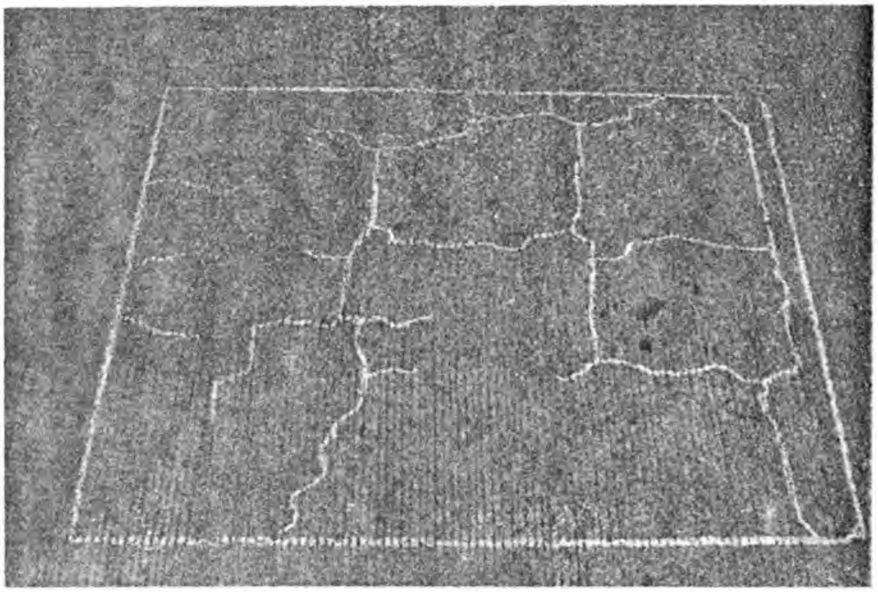
>10 to ≤15'



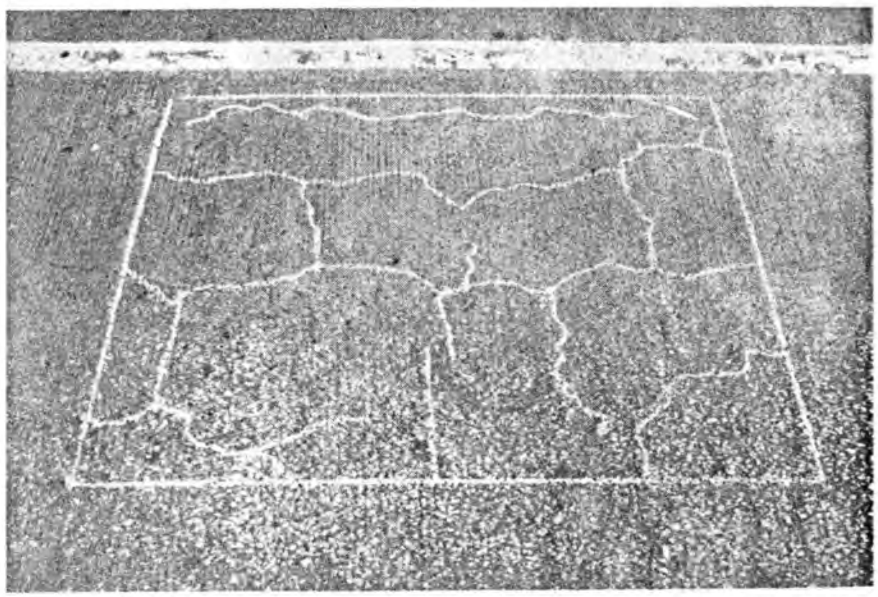
>10 to ≤15'

LEGEND: Grids are all (4 x 3) feet.

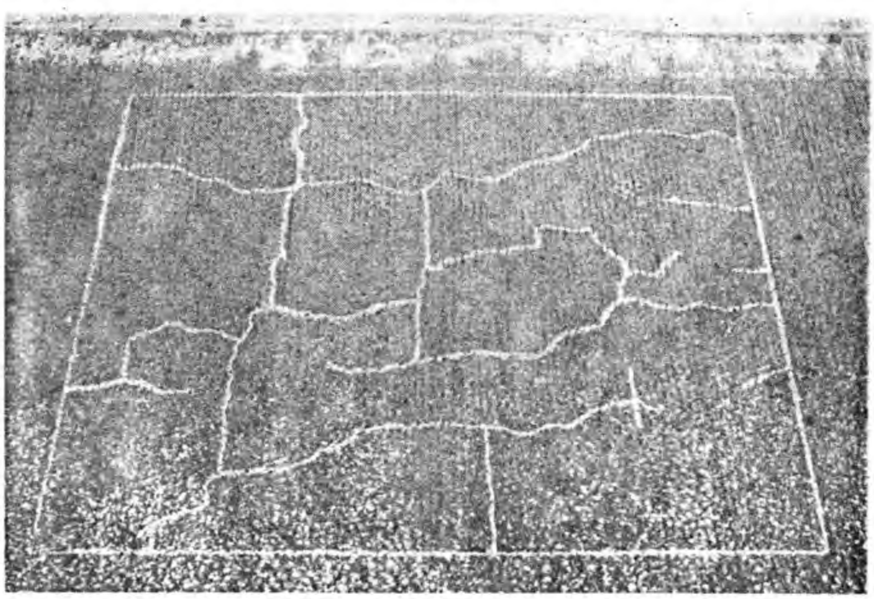
APPENDIX II



>15'



>15'



>15'

LEGEND: Grids are all (4 x 3) feet.

APPENDIX III

The study was devised to survey one lane of each deck. For the most part, the lane to be surveyed was the outermost thru driving lane.

Due to the great variation in length of these overlaid structures, i.e., ranging from 62 feet to 6,829 feet, additional length limiting criteria was set up as follows:

1. Bridge lengths less than 300 feet
   a. Survey all spans
2. Bridge lengths of 300 to 600 feet
   a. Survey either first and/or last spans plus additional spans with a total survey length of approximately 300 feet.
3. Bridge lengths of 601 to 1050 feet
   a. Survey either first and/or last spans plus additional spans with a total survey length of approximately 500 feet.
4. Bridge lengths of 1051 to 2000 feet
   a. Survey either first and/or last spans plus additional spans with a total survey length of approximately 800 feet.
5. Bridge lengths of over 2000 feet
   a. Survey either first and/or last spans plus additional spans with a total survey length of one-half of the bridge length. Note Exception - Bridges open to traffic less than 3 years in 1982-1983, the same total survey length of approximately 1000 feet was tested in 1989-1990 unless excessive cracking was noted.

Appendix IV
Statewide List of Bridges with PC Concrete Overlays
as of January 1,1990

| Bridge No. | | Overlay |
|---|---|---|
| A- 53R1 | E.B. | LC |
| A- 53R1 | W.B. | LC |
| A- 93R | E.B. | LC |
| A- 93R | W.B. | LC |
| A- 139R | | LC |
| A- 141R | | LC |
| A- 207R | E.B. | LC |
| A- 211R | E.B. | LC |
| A- 212R | | LC |
| A- 213R | W.B. | LC |
| A- 221R | | LC |
| A- 240R | | LC |
| A- 320R2 | | LC |
| A- 531R | N.B. | LC |
| A- 531R | S.B. | LC |
| A- 610R | N.B. | LC |
| A- 610R | S.B. | LC |
| A- 798R | | LC |
| A- 800R | | LC |
| A- 856R | W.B. | LC |
| A- 887 | E.B. | LC |
| A- 961R | | LC |
| A- 964R | | LC |
| A- 967R | E.B. | LC |
| A- 967R | W.B. | LC |
| A- 970R | W.B. | LC |
| A- 971R | W.B. | LC |
| A-1083R | N.B. | LC |
| A-1083R | S.B. | LC |
| A-1084R | N.B. | LC |
| A-1084R | S.B. | LC |
| A-1085R | N.B. | LC |
| A-1085R | S.B. | LC |
| A-1086R | N.B. | LC |
| A-1086R | S.B. | LC |
| A-1087R | | LC |
| A-1089R | | LC |
| A-1090R | | LC |
| A-1091R | | LC |
| A-1236R | | LC |
| A-1237R | | LC |
| A-1310R | | LC |
| A-1347R | N.B. | LC |
| A-1347R | S.B. | LC |
| A-1349R | N.B. | LC |
| A-1349R | S.B. | LC |
| A-1643R | | LC |
| A-1669R | N.B. | LC |
| A-1669R | S.B. | LC |
| A-1685R1 | S.B. | LC |
| A-1686R | N.B. | LC |
| A-1686R1 | S.B. | LC |

| Bridge No. | | Overlay |
|---|---|---|
| A-1728R | E.B. | LC |
| A-1728R | W.B. | LC |
| A-1733R | E.B. | LC |
| A-1733R | W.B. | LC |
| A-1739R | E.B. | LC |
| A-1739R | W.B. | LC |
| A-1744A | S.B. | LC |
| A-1763R | S.B. | LC |
| A-1796R | W.B. | LC |
| A-1892R | | LC |
| A-1893R | | LC |
| A-2017R | | LC |
| A-2048R | | LC |
| A-2049R | | LC |
| A-2163R | E.B. | LC |
| A-2163R | W.B. | LC |
| A-2164R | E.B. | LC |
| A-2164R | W.B. | LC |
| A-2165R | E.B. | LC |
| A-2165R | W.B. | LC |
| A-2255R | E.B. | LC |
| A-2255R | W.B. | LC |
| A-2258R | E.B. | LC |
| A-2258R | W.B. | LC |
| A-2318R | E.B. | LC |
| A-2318R | W.B. | LC |
| A-2326R | E.B. | LC |
| A-2326R | W.B. | LC |
| A-2368R | E.B. | LC |
| A-2368R | W.B. | LC |
| A-2386R | E.B. | LC |
| A-2386R | W.B. | LC |
| A-2394R | E.B. | LC |
| A-2394R | W.B. | LC |
| A-2600R | E.B. | LC |
| A-2600R | W.B. | LC |
| A-2672 | | LC |
| A-2682 | | LC |
| A-2683 | N.B. | LC |
| A-2683 | S.B. | LC |
| A-2684 | N.B. | LC |
| A-2684 | S.B. | LC |
| A-2738 | | LC |
| A-2938 | S.B. | LC |
| A-2939 | S.B. | LC |
| A-3004 | E.B. | LC |
| A-3005 | E.B. | LC |
| A-3085 | | LC |
| A-3623 | | LC |
| A-3735 | E.B. | LC |
| A-3808 | | LC |
| A-3809 | | LC |

| Bridge No. | | Overlay |
|---|---|---|
| A-3810 | | LC |
| A-3823 | E.B. | LC |
| A-3824 | E.B. | LC |
| F- 314R2 | W.B. | LC |
| G- 337R1 | E.B. | LC |
| H- 572R1 | | LC |
| H- 994R | | LC |
| H- 995R | | LC |
| J- 493R | | LC |
| J- 991R | W.B. | LC |
| K- 393R1 | | LC |
| K- 690R1 | E.B. | LC |
| L- 518 | | LC |
| L- 547R1 | E.B. | LC |
| L- 611R | E.B. | LC |
| L- 641R1 | S.B. | LC |
| L- 658R1 | N.B. | LC |
| L- 669R | E.B. | LC |
| L- 717R | | LC |
| L- 774R | | LC |
| L- 967R1 | E.B. | LC |
| L- 967R1 | W.B. | LC |
| L- 970R | | LC |
| L- 972R | E.B. | LC |
| L- 972R | W.B. | LC |
| L- 973R | E.B. | LC |
| L- 973R | W.B. | LC |
| Z- 557R | | LC |
| A- 532R | S.B. | LC w/CP |
| A-1088R | E.B. | LC w/CP |
| A-1088R | W.B. | LC w/CP |
| A-1092R | E.B. | LC w/CP |
| A-1093R | E.B. | LC w/CP |
| A-1094R | | LC w/CP |
| A-1316R | | LC w/CP |
| A-1409R | N.B. | LC w/CP |
| A-1647R | | LC w/CP |
| A-1685R | N.B. | LC w/CP |
| A-1750R | N.B. | LC w/CP |
| A-1750R | S.B. | LC w/CP |
| L- 53R1 | | LC w/CP |
| L- 887R1 | | LC w/CP |
| L- 888R | | LC w/CP |
| L- 889R | | LC w/CP |
| L- 891R | | LC w/CP |
| A-1043R | W.B. | LC/LSC |
| A-1076R | N.B. | LC/LSC |
| A-1251 | | LC/LSC |
| A-2306R | | LC/LSC |
| A-2307R | | LC/LSC |
| A-2613R | | LC/LSC |
| A-2690R | | LC/LSC |

LC=Latex Concrete,LSC=Low Slump,LC/LSC=either LC or LSC,LC w/CP=LC w/Cathodic Protection

Appendix IV (Continued)

| Bridge No. | | Overlay | Bridge No. | | Overlay | Bridge No. | | Overlay |
|---|---|---|---|---|---|---|---|---|
| A-2691R | | LC/LSC | A- 797R | N.B. | LSC | A-1373R | N.B. | LSC |
| A-2779R | N.B. | LC/LSC | A- 797R | S.B. | LSC | A-1373R | S.B. | LSC |
| A-2779R | S.B. | LC/LSC | A- 799R | N.B. | LSC | A-1375R1 | S.B. | LSC |
| A-2780R | N.B. | LC/LSC | A- 799R | S.B. | LSC | A-1399R | | LSC |
| A-2780R | S.B. | LC/LSC | A- 830R | N.B. | LSC | A-1400R | | LSC |
| A-2782R | N.B. | LC/LSC | A- 830R | S.B. | LSC | A-1414R | W.B. | LSC |
| A-2782R | S.B. | LC/LSC | A- 831R | | LSC | A-1415R | W.B. | LSC |
| A-2870R | | LC/LSC | A- 832R | E.B. | LSC | A-1465R | | LSC |
| A-2936R | | LC/LSC | A- 944R | N.B. | LSC | A-1466R | N.B. | LSC |
| A-3096R | | LC/LSC | A- 944R | S.B. | LSC | A-1466R | S.B. | LSC |
| A-4017 | E.B. | LC/LSC | A- 945R | N.B. | LSC | A-1487R | | LSC |
| A-4497 | | LC/LSC | A- 945R | S.B. | LSC | A-1576R | S.B. | LSC |
| G- 411R1 | | LC/LSC | A- 946R | N.B. | LSC | A-1577R | S.B. | LSC |
| G- 865R1 | S.B. | LC/LSC | A- 946R | S.B. | LSC | A-1579R | S.B. | LSC |
| L- 458R | | LC/LSC | A- 953R | N.B. | LSC | A-1580R | N.B. | LSC |
| L- 459R | | LC/LSC | A- 953R | S.B. | LSC | A-1583R | N.B. | LSC |
| A- 77R | E.B. | LSC | A-1051R | N.B. | LSC | A-1595R | N.B. | LSC |
| A- 77R | W.B. | LSC | A-1051R | S.B. | LSC | A-1595R | S.B. | LSC |
| A- 110R1 | E.B. | LSC | A-1052R | N.B. | LSC | A-1609R | | LSC |
| A- 110R1 | W.B. | LSC | A-1052R | S.B. | LSC | A-1614R | S.B. | LSC |
| A- 114R2 | N.B. | LSC | A-1056R | | LSC | A-1648R | E.B. | LSC |
| A- 114R2 | S.B. | LSC | A-1057R | N.B. | LSC | A-1648R | W.B. | LSC |
| A- 119R | | LSC | A-1072R | | LSC | A-1662R1 | N.B. | LSC |
| A- 144R | | LSC | A-1074R | | LSC | A-1662R1 | S.B. | LSC |
| A- 198R | N.B. | LSC | A-1075R | N.B. | LSC | A-1680R | W.B. | LSC |
| A- 199R | N.B. | LSC | A-1075R | S.B. | LSC | A-1682R | N.B. | LSC |
| A- 201R | E.B. | LSC | A-1077R | | LSC | A-1682R | S.B. | LSC |
| A- 201R | W.B. | LSC | A-1080R | N.B. | LSC | A-1683R | S.B. | LSC |
| A- 203R1 | E.B. | LSC | A-1080R | S.B. | LSC | A-1684R | N.B. | LSC |
| A- 203R1 | W.B. | LSC | A-1096R | | LSC | A-1684R | S.B. | LSC |
| A- 208R1 | E.B. | LSC | A-1122R | | LSC | A-1688R1 | N.B. | LSC |
| A- 208R1 | W.B. | LSC | A-1159R | N.B. | LSC | A-1689R | S.B. | LSC |
| A- 222R | | LSC | A-1159R | S.B. | LSC | A-1700R1 | | LSC |
| A- 226R | N.B. | LSC | A-1192R | | LSC | A-1702R | N.B. | LSC |
| A- 226R | S.B. | LSC | A-1200R | N.B. | LSC | A-1703R | S.B. | LSC |
| A- 283R | N.B. | LSC | A-1201R | N.B. | LSC | A-1705R | S.B. | LSC |
| A- 283R | S.B. | LSC | A-1202R | S.B. | LSC | A-1713R | N.B. | LSC |
| A- 289R1 | E.B. | LSC | A-1203R | S.B. | LSC | A-1713R | S.B. | LSC |
| A- 294R | E.B. | LSC | A-1206R | | LSC | A-1716R | N.B. | LSC |
| A- 296R | W.B. | LSC | A-1207R | | LSC | A-1716R | S.B. | LSC |
| A- 303R | E.B. | LSC | A-1225R | N.B. | LSC | A-1720R | | LSC |
| A- 304R | W.B. | LSC | A-1225R | S.B. | LSC | A-1721R | | LSC |
| A- 454R1 | N.B. | LSC | A-1226R | N.B. | LSC | A-1723R | E.B. | LSC |
| A- 470R | | LSC | A-1226R | S.B. | LSC | A-1723R | W.B. | LSC |
| A- 480R1 | N.B. | LSC | A-1238R | N.B. | LSC | A-1726R | | LSC |
| A- 480R1 | S.B. | LSC | A-1238R | S.B. | LSC | A-1730R | | LSC |
| A- 576R | | LSC | A-1239R | N.B. | LSC | A-1732R | | LSC |
| A- 591R | N.B. | LSC | A-1242R | | LSC | A-1736R | | LSC |
| A- 591R | S.B. | LSC | A-1243R | E.B. | LSC | A-1741R | N.B. | LSC |
| A- 607R | N.B. | LSC | A-1243R | W.B. | LSC | A-1742R | | LSC |
| A- 607R | S.B. | LSC | A-1276R | S.B. | LSC | A-1743R | N.B. | LSC |
| A- 650R | | LSC | A-1305R | | LSC | A-1743R | S.B. | LSC |
| A- 658R | | LSC | A-1306R | | LSC | A-1744R | N.B. | LSC |
| A- 723R | S.B. | LSC | A-1358R1 | S.B. | LSC | A-1746R | N.B. | LSC |

LC=Latex Concrete,LSC=Low Slump,LC/LSC=either LC or LSC,LC w/CP=LC w/Cathodic Protection

# Appendix IV (Continued)

| Bridge No. | Overlay | Bridge No. | Overlay | Bridge No. | Overlay |
|---|---|---|---|---|---|
| A-1746R S.B. | LSC | A-2223R S.B. | LSC | A-2432R S.B. | LSC |
| A-1747R N.B. | LSC | A-2224 S.B. | LSC | A-2441R N.B. | LSC |
| A-1747R S.B. | LSC | A-2225 N.B. | LSC | A-2441R S.B. | LSC |
| A-1753R | LSC | A-2225 S.B. | LSC | A-2452R N.B. | LSC |
| A-1754R | LSC | A-2226 N.B. | LSC | A-2452R S.B. | LSC |
| A-1755R S.B. | LSC | A-2227 S.B. | LSC | A-2454R | LSC |
| A-1764R | LSC | A-2228 N.B. | LSC | A-2455R | LSC |
| A-1765R1 | LSC | A-2229 S.B. | LSC | A-2459R N.B. | LSC |
| A-1781R | LSC | A-2230 S.B. | LSC | A-2459R S.B. | LSC |
| A-1800R1 | LSC | A-2231 N.B. | LSC | A-2462R | LSC |
| A-1820R | LSC | A-2232 | LSC | A-2463R | LSC |
| A-1841R | LSC | A-2233 | LSC | A-2471R | LSC |
| A-1842R | LSC | A-2234 | LSC | A-2472R | LSC |
| A-1843R S.B. | LSC | A-2235 | LSC | A-2490R | LSC |
| A-1844R | LSC | A-2249R N.B. | LSC | A-2491R | LSC |
| A-1853R | LSC | A-2256R | LSC | A-2492R | LSC |
| A-1928R N.B. | LSC | A-2257R | LSC | A-2493R | LSC |
| A-1929R N.B. | LSC | A-2264R N.B. | LSC | A-2494R N.B. | LSC |
| A-1930R S.B. | LSC | A-2264R S.B. | LSC | A-2494R S.B. | LSC |
| A-1931R N.B. | LSC | A-2265R | LSC | A-2495R | LSC |
| A-1931R S.B. | LSC | A-2267R | LSC | A-2502R N.B. | LSC |
| A-1932R | LSC | A-2268R | LSC | A-2502R S.B. | LSC |
| A-1936R N.B. | LSC | A-2269R N.B. | LSC | A-2505R N.B. | LSC |
| A-1937R S.B. | LSC | A-2269R S.B. | LSC | A-2505R S.B. | LSC |
| A-1938R | LSC | A-2270R N.B. | LSC | A-2511R | LSC |
| A-1940R | LSC | A-2270R S.B. | LSC | A-2512R | LSC |
| A-1941R | LSC | A-2271R N.B. | LSC | A-2513 | LSC |
| A-1942R N.B. | LSC | A-2271R S.B. | LSC | A-2514 E.B. | LSC |
| A-1945R1 N.B. | LSC | A-2275R N.B. | LSC | A-2522R | LSC |
| A-1982R1 N.B. | LSC | A-2275R S.B. | LSC | A-2523R | LSC |
| A-1987R | LSC | A-2279R N.B. | LSC | A-2551R E.B. | LSC |
| A-1990R | LSC | A-2279R S.B. | LSC | A-2552R E.B. | LSC |
| A-1991R N.B. | LSC | A-2282R N.B. | LSC | A-2617R | LSC |
| A-1991R S.B. | LSC | A-2282R S.B. | LSC | A-2641R N.B. | LSC |
| A-2019R N.B. | LSC | A-2283R N.B. | LSC | A-2642R N.B. | LSC |
| A-2029R N.B. | LSC | A-2283R S.B. | LSC | A-2642R S.B. | LSC |
| A-2067R N.B. | LSC | A-2304R | LSC | A-2729R | LSC |
| A-2067R S.B. | LSC | A-2312R S.B. | LSC | A-2731R N.B. | LSC |
| A-2069R N.B. | LSC | A-2317R N.B. | LSC | A-2816R S.B. | LSC |
| A-2069R S.B. | LSC | A-2317R S.B. | LSC | A-2847 N.B. | LSC |
| A-2092R E.B. | LSC | A-2322R | LSC | A-2908 N.B. | LSC |
| A-2092R W.B. | LSC | A-2405R N.B. | LSC | A-2908 S.B. | LSC |
| A-2116 E.B. | LSC | A-2405R S.B. | LSC | A-2984 S.B. | LSC |
| A-2116 W.B. | LSC | A-2406R | LSC | A-2985 N.B. | LSC |
| A-2117 | LSC | A-2414R | LSC | A-2986 S.B. | LSC |
| A-2118 | LSC | A-2415R | LSC | A-2987 N.B. | LSC |
| A-2119 | LSC | A-2419R N.B. | LSC | A-3047 | LSC |
| A-2132 N.B. | LSC | A-2419R S.B. | LSC | A-3128 | LSC |
| A-2132 S.B. | LSC | A-2420R | LSC | A-3136 E.B. | LSC |
| A-2221R N.B. | LSC | A-2427R N.B. | LSC | A-3136 W.B. | LSC |
| A-2221R S.B. | LSC | A-2428R S.B. | LSC | A-3162 S.B. | LSC |
| A-2222R N.B. | LSC | A-2429R N.B. | LSC | A-3207R1 E.B. | LSC |
| A-2222R S.B. | LSC | A-2430R | LSC | A-3207R1 W.B. | LSC |
| A-2223R N.B. | LSC | A-2431R N.B. | LSC | A-3263R | LSC |

LC=Latex Concrete,LSC=Low Slump,LC/LSC=either LC or LSC,LC W/CP=LC W/Cathodic Protection

Appendix IV (Continued)

| Bridge No. | | Overlay | Bridge No. | | Overlay | Bridge No. | | Overlay |
|---|---|---|---|---|---|---|---|---|
| A-3266R | | LSC | A-3831 | | LSC | L- 293R | S.B. | LSC |
| A-3267R | | LSC | A-4059 | S.B. | LSC | L- 319R | | LSC |
| A-3289 | | LSC | A-4060 | | LSC | L- 354R1 | S.B. | LSC |
| A-3292R | E.B. | LSC | A-4134 | | LSC | L- 361R1 | | LSC |
| A-3351 | E.B. | LSC | A-4165R | | LSC | L- 379R2 | W.B. | LSC |
| A-3352 | | LSC | A-4166R | | LSC | L- 472R1 | S.B. | LSC |
| A-3353 | | LSC | A-4167R | | LSC | L- 474R1 | S.B. | LSC |
| A-3483 | | LSC | F- 175R3 | S.B. | LSC | L- 475R1 | S.B. | LSC |
| A-3494 | | LSC | F- 759R2 | | LSC | L- 501R | S.B. | LSC |
| A-3496 | | LSC | F- 956R2 | | LSC | L- 638R | | LSC |
| A-3498 | | LSC | H- 841R | | LSC | L- 642R1 | N.B. | LSC |
| A-3500 | | LSC | J- 134R | | LSC | L- 682R2 | E.B. | LSC |
| A-3520 | | LSC | J- 339R1 | | LSC | L- 684R1 | E.B. | LSC |
| A-3521R | | LSC | J- 429R1 | | LSC | L- 692R1 | | LSC |
| A-3522 | E.B. | LSC | J- 619R | | LSC | L- 798R | E.B. | LSC |
| A-3547 | | LSC | J- 704R | | LSC | L- 799R | W.B. | LSC |
| A-3594 | W.B. | LSC | K- 263R | W.B. | LSC | L- 865R1 | E.B. | LSC |
| A-3617R | | LSC | K- 290R1 | | LSC | L- 873R2 | | LSC |
| A-3664 | E.B. | LSC | K- 415R | | LSC | L- 935R | W.B. | LSC |
| A-3664 | W.B. | LSC | K- 524R1 | W.B. | LSC | L- 948R | W.B. | LSC |
| A-3665 | W.B. | LSC | K- 697R | | LSC | L- 949R | W.B. | LSC |
| A-3666 | E.B. | LSC | K- 941R | | LSC | L- 981R | E.B. | LSC |
| A-3671 | | LSC | L- 146R1 | E.B. | LSC | L- 981R | W.B. | LSC |
| A-3706 | | LSC | L- 248R | S.B. | LSC | L-1003R | | LSC |
| A-3792 | | LSC | L- 280R | S.B. | LSC | N- 942R | | LSC |
| A-3830 | E.B. | LSC | | | | | | |

LC=Latex Concrete,LSC=Low Slump,LC/LSC=either LC or LSC,LC w/CP=LC w/Cathodic Protection